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On Swing Pricing and Systemic Risk Mitigation

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Abstract

Swing pricing allows a fund manager to transfer to redeeming or subscribing investors the costs associated with their trading activity, thus potentially discouraging large flows. This liquidity management tool, which is already used in major jurisdictions, may also help mitigate systemic risk. Here we develop and apply a methodology to investigate whether swing pricing does in fact help dampen flows out of funds, especially during periods of market stress. Drawing on evidence of first-mover advantage within a group of 'swinging' corporate bond funds, we provide policy considerations for enhancing the tool's effectiveness as a systemic risk mitigant.

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INTRODUCTION

Mutual fund managers, operating in many jurisdictions, are able to utilize certain tools for manging liquidity risk of open-ended funds. Some examples of these include: redemption fees, redemptions in-kind, gates, and suspensions.[2] Swing pricing falls within this class of tools, and has experienced a considerable gain in popularity over the past decade.[3] Authorities in the largest European domiciles for UCITS-eligible funds, such as, the U.K., France, Ireland, and Luxembourg, now permit the tool's usage either explicitly, or implicitly.[4] Most recently, the Securities and Exchange Commission (SEC) permitted implementation of swing pricing in the U.S.

Swing pricing, defined simply, is a process of adjusting an open-ended fund's (referred to as 'fund' henceforth) share value, so as to transfer to redeeming, or subscribing investors, costs associated with their trading activity. More specifically, as investors redeem from a fund, the fund manager may be required to liquidate assets, in order to make cash payouts. Such activity incurs certain trading costs, which are typically shared equally amongst redeeming, and the remaining (non-redeeming) investors. The decline in the value of shares held by the remaining investors occurring as a result, is referred to as 'dilution.' Swing pricing aims to protect longer-term investors from dilution effects, by transferring aforementioned costs—either fully, on in large part—to redeeming investors which prompted the trading activity.

Notwithstanding its possible merits as a liquidity management (anti-dilution) tool for individual funds, wide-acceptance of swing pricing amongst regulators has been, to some extent, the result of its perceived ability to help mitigate systemic risk.[5] However, to date, and to the best of our knowledge, no empirical work has been conducted evaluating effectiveness of swing pricing in this particular dimension. This paper is an initial attempt at plugging this gap methodologically and via empirical illustrations.

The plan for this paper is as follows. Section I describes how funds could pose risks for systemic stability, via the presence of so-called 'first-mover advantage.' Section II provides details on the mechanics of swing pricing, and outlines how it could aid in mitigating such risks. Also, in order to better undertstand, and predict the effects of swing pricing on fund return dynamics, a simulation exercise is developed. Section III discusses some open issues around the tool's implementation; specifically, investor protection concerns, and potential impediments to its adoption in the specific case of the U.S. Drawing on, in part, lessons from

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[2] For an overview of these liquidity management tools, please refer to: IOSCO – International Organization of Securities Commissions (2012), BlackRock (2014), and ICI – Investment Company Institute (2016).

[3] According to a recent IOSCO survey of twenty-six countries, eleven now permit implementation of swing pricing, the majority of which are in Europe. For more details, please refer to: 'Liquidity Management Tools in Collective Investment Schemes: Results from an IOSCO Committee 5 survey to members, Final report,' December, 2015.

[4] UCITS refers to, 'Undertakings for Collective Investment in Transferable Securities.' UCITS funds can be sold to any investor within the EU under a harmonized regulatory regime. They are considered to have a strong brand identity across Europe, Asia and South America and are distributed for sale in over fifty countries.

[5] For a conceptual discussion of the mechanisms by which funds could create systemic instability, please see: IMF, GFSR – Global Financial Stability Report (Chapter 3: April, 2015).

simulations in Section II, Section IV describes our proposed empricial strategy to assess the effectiveness of swing pricing in reducing first mover advantage, and provides important considerations around sample construction. Subsequently, empirical results of the assessment and some robustness checks are reported. Building on the baseline described in IV, Section V explores a 'generalized' empirical strategy based on pooling information across multiple funds. Assessing effectiveness of swing pricing by examining the informational content of redemption patterns is briefly explored in Section VI. In the context of empirical evidence uncovered, Section VII provides considerations for improving implementation of swing pricing from the perspective of achieving effective systemic risk mitigation. Section VIII concludes, and provides some directions for future research.

I. Systemic Risk and Open-Ended Mutual Funds: Some Context

"*Authorities should make liquidity risk management tools available to open-ended funds to reduce first-mover advantage, where it may exist. Such tools may include swing pricing, redemption fees, and other anti-dilution methods. In this regard, IOSCO should review its existing guidance and, as appropriate, enhance it.*"

- Financial Stability Board, Consultative Document, June 2016

Investors in (open-ended) funds could have a 'first-mover advantage' (FMA) in redeeming before others. Such an advantage may accelerate redemptions, and trigger a run (BlackRock, 2014). And while a run on a fund has historically been considered an extreme tail event, current market conditions of low and/or declining liquidity in corporate bond markets have served to heighten systemic concerns.[6]

In general, FMA stems from the fact that these funds issue shares redeemable on a daily basis, and the way redemptions are paid out.[7] Shares of redeeming investors are valued at end-of-day floating, per-share net asset value (NAV), and paid later in cash. The same NAV applies to subscribing investors.[8] The NAV varies with the value of the underlying portfolio of assets, taking into account trading costs incurred due to asset liquidation as investors redeem from the fund.[9] Irrespective of which investors prompted trading, costs are incurred by the fund as a whole, diluting the interest of *all* investors in the fund. The main cost

[6] Unlike banks, which derive financing with issuance of short-term debt, exposing them to both solvency and liquidity risks, mutual funds issue shares with end investors bearing all investment risk. Therefore, solvency risk in funds is very low, in general, with high leverage mostly limited to hedge funds and private equity funds. These entities, however, represent a small share of the overall asset management industry (GFSR, 2015).

[7] It this paper, redemptions from funds refer specifically to *net*-redemptions, since on any dealing day, investors can trade out of, and in to, the fund.

[8] More specifically, the NAV is derived by dividing the total value of all assets (and/or cash) in a fund's portfolio, less any liabilities, by the number of shares outstanding. Valuation typically takes place at the mid, or last-traded price. However, the fund manager buys underlying assets at ask, and sells at bid price.

[9] In what follows, attention will be restricted to redemptions, and liquidity management actions which may be executed as a result.

components are bid-ask spreads and market impact costs, which will to a large part be a function of prevailing market liquidity. However, other specific costs associated with trading—brokerage and clearing fees, foreign exchange, commissions, taxes, and stamp duties, for example—may be relevant. While being small in normal market conditions, in times of heightened stress and illiquidity, trading costs could become substantial.

Investors arriving the day after the first round of redemptions can thus expect to redeem their shares at a lower, diluted NAV, given that most of the trading costs associated with asset liquidation will fall upon investors who are invested for the long term, or who will redeem later.[10] In deteriorating liquidity conditions, slower to redeem investors may end up holding shares in an increasingly illiquid portfolio, whose NAV may fall at an accelerated rate, as illiquidity premia rise. Asset liquidation may need to be carried out at heavily discounted 'fire-sale' prices, setting in motion an adverse feedback loop—prompting further redemptions, and reinforcing the downward spiral in asset prices and NAV. FMA can hence be described as being the result of 'strategic complementarities' amongst fund investors, where redemption activity by one investor, or a group of investors, motivates other investors to also sell their shares in order to avoid dilution (see Goldstein et al., 2016).

Another factor supporting existence of FMA are valuation dynamics in the less liquid segments of the securities markets – mainly fixed income bonds, small cap stocks and emerging markets securities. During periods of high volatility, and declining prices, valuations for less-traded securities can often *lag* the market; see Barclays (2015). This leads to an overvaluation, since fund values are determined based on prices that exceed the true market values of these assets. Investors redeeming early will receive a NAV that is actually inflated relative to its fundamental value. Remaining investors, in turn, end up holding shares worth less than the stated NAV. The higher the redemptions at the inflated NAV, the greater the dilution of the remaining investors. In order to meet redemptions, many fund managers look to sell more liquid segments of their portfolios first.[11] This leads to portfolios becoming less liquid, with a greater exposure to assets priced with a lag. Elevated riskiness of the portfolio renders the fund less attractive to non-redeeming investors, making them more likely to redeem in turn.

Even in the absence of a common sector-wide shock, a run triggered at the fund level could in principle create systemic disruptions via direct or indirect channels. Investors holding assets liquidated in fire-sales will suffer mark-to-market losses, even having not directly invested in the particular fund engaged in trading. These affected third parties may rebalance

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[10] When faced with small redemptions, a fund manager may choose to use available cash/liquidity buffers to make payouts. But if redemptions exceed the buffer, as might be the case in stressed market conditions, assets will have to be liquidated to make redemption pay-outs. There is an argument against committing to deplete liquidity buffers, which goes as follows. Holding cash helps avoid fire sales of illiquid assets if significant net redemptions occur. However, the need to rebuild cash buffers at time $t+1$ implies predictable sales of illiquid assets and hence a predictable decline in NAV. This generates an FMA at t, leading to a run on the fund. See Zheng (2016) for more details on the underlying theoretical model.

[11] This is the so-called 'waterfall' approach for asset liquidation; see Scholes (2000). However, an alternative 'prorata' approach may be followed, which refers to selling all securities in the portfolio in the same proportion (see Cetorelli et al., 2016, and also Bouveret, 2017). Prorata ensures portfolio composition does not deviate from the stated investment policy.

their portfolios, triggering another round of liquidations—which may not necessarily be confined to a single asset class. The dynamic set in motion may lead to further price dislocations, across a range of asset classes, with sharp amplifications in market volatility and trading spreads. Absent potential rebalancing, adverse spillovers to the wider-market may occur as a result of price correlation across different asset classes. In the extreme, a general impairment of market-based financing mechanisms may ensue.

II. MECHANICS OF SWING PRICING

Swing pricing can be categorized as either 'partial' or 'full', with the former coming into effect when net flows exceed a pre-defined 'swing threshold.' The amount by which NAV for redeeming investors is adjusted downwards (in the case of net redemptions) is known as the 'swing factor.'[12] The swing factor should thus incorporate costs related to the bid-ask spread and market impact, as well as other specific costs associated with trading, listed in the previous section. Full swing pricing implies a NAV adjustment at each dealing date, regardless of the levels of net flows. In contrast to the partial variant (on which focus of this paper is restricted), full swing pricing has, thus far, been less preferred. The main reasons cited for this are: (i) the task of implementing the tool on a higher frequency basis (i.e., any day there are net in-, or -outflows), can be operationally cumbersome; and (ii) it can in potentially exacerbate NAV volatility.[13] Further details on swing parameters –in the case of partial swing pricing– and considerations which may go in to their calibration, are discussed in Box 1 below.[14]

Operationally, swing pricing parameters are typically governed by a stand-alone valuation committee. Such a committee is created by each fund under the supervision of its 'Board of Directors,' or equivalent body, and reviews swing parameters usually quarterly, or monthly. However, if market conditions change, it is understood that a more frequent review can be undertaken, i.e., in order to adapt parameters in a timely manner. Overall, the committee is assumed to set its parameters within some justifiable bounds.

Successful implementation of swing pricing is also reliant on the presence of conducive market infrastructure. Specifically, this should facilitate funds' gathering of daily information on trade flow and related costs—on the basis of which the decision to implement swing pricing will be made—in a timely manner, prior to the time of end-of-day NAV calculations. More details on such infrastructural aspects will be provided in the following section.

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[12] Net subscriptions would trigger an upward adjustment.

[13] Another aspect of full swing pricing, not explicitly obvious, is that it can be viewed as resembling a fixed fee on transactions - a practice widely considered unpopular with investors.

[14] For an comprehensive overview of parameter calibration considerations, and current practices, see the 2015 survey conducted by the Association of the Luxemburg Fund Industry (ALFI). The survey targeted 65 largest asset managers operating in Luxembourg. They represented approximately USD 2,500 billion of assets under management (AuM), which is 69 percent of the assets of Luxembourg domiciled funds (as in July 2015). Total AuM of respondents employing swing pricing amounted to USD 1900 billion of net assets- i.e., 54 percent of the total AuM of the Luxembourg fund industry. More than half of the asset managers not yet applying swing pricing stated they were in the process of evaluating its merits.

A. Swing Pricing as a Systemic Risk Mitigant

By adjusting/swinging the NAV downwards—in case of net redemptions—swing pricing leads to costs associated with asset liquidation being borne, in part, or fully, by redeeming investors. The remaining, non-redeeming investors, are thus (largely) protected from dilution effects. Proceeds recovered via swing pricing are reinvested for the benefit of the fund, enhancing returns for longer-term investors.

A reduction in FMA, via implementation of swing pricing, should come about because the anti-dilution benefit mitigates incentives for investors to redeem early, since they will not be subject to receiving a reduced NAV—i.e., if the swing factor is sufficient to cover all trading costs and effects of lagged pricing effects. Moreover, investors may be deterred from redeeming in large volumes if they feared being penalized by a lower (swung) NAV. As will be discussed in more detail later, effectiveness in achieving these objectives depends greatly on the calibration of swing parameters.

Box 1. Swing Parameter Calibration

The swing threshold:

While in principle, this threshold should reflect a point at which net flows prompt the fund manager to liquidate non-cash assets, in practice it is defined by net flows as a percentage of NAV. Threshold calibration can be influenced by various factors: (i) fund size – larger funds may have higher threshold levels; (ii) liquidity characteristics of assets held in portfolio– presence of more illiquid assets should bring down the threshold; (iii) specific costs associated with trading – higher brokerage, clearing fees and taxes, for example, might encourage adoption of lower thresholds; and (iv) the extent to which funds can maintain significant liquid asset/cash buffers could push thresholds upwards. Also, information on historical redemption flows and volatility, in normal and stressed periods, could be analyzed to aid in threshold calibration.

The swing factor:

The objective is to adjust the price downwards by a certain factor, in the direction of the bid price. Once the NAV is calculated using the standard method, the factor –incorporating costs corresponding to bid-ask spread, market impact and other costs associated with trading markets – can be applied. Further refinements around determining swing parameters could include, for example, swing factor tiering – to take into account the size of flows. Caps on factors can be considered, and which may be asset class-specific. In practice, swing factors typically lie in the range of between 0.5 to 3 percent, and are applied symmetrically for net inflows and outflows. However, asymmetric factors are also a feasible option, given certain types of costs – e.g. U.K. Stamp Duty, which is incurred only during subscription activity.

B. Anti-diution Properties of Swing Pricing: A Simulation Exercise

Given the significance of the anti-dilution effect of swing pricing in potentially reducing FMA (outlined above), we conduct a stylized simulation exercise to understand how the evolution of NAV, following an initial redemption shock, may differ between swinging, and non-swinging funds. This exercise, in addition to better illustrating the mechanics of swing pricing, is intended to provide directions for design of our subsequent empirical analysis.

Simulation design assumptions:

Assume two funds, one swings (SP), and other does not (NSP), and which are otherwise identical. Both start out on day, τ = -1, at a baseline NAV of USD 100. On day τ = 0, there is a one-time redemption shock, in which investors redeem 5 percent of each fund's assets, prompting trading activity by fund managers. The redemption level is assumed to be sufficiently large, so as to exceed any existing swing threshold. It is also assumed that no trading cost are incurred on τ = 0, and that it accrues in equal amounts only *after* the redemption date, on the three subsequent trading days, τ = 1, 2, and 3. The cost is assumed to amount to 2 percent of the value of the redemptions.[15] To enable a comparison across different swing factors, we track how NAV of NSP evolves in relation to the NAV of SP. Swing factors considered are 2, and 3 percent. It is assumed that the NAV, absent any trading activity, would have remained at USD 100 between τ = -1 and τ = 3. No further swing pricing activity is assumed to take place during the simulation period. Simulated NAV paths are provided in Table 1.

Table 1. Impact of Swinging on NAV Paths

	NSP	SP	
Time		Swing factor	
		2 percent	3 percent
τ =-1	100.00	100.00	100.00
τ = 0 *	100.00	98.00	97.00
τ = 1	99.96	100.07	100.12
τ = 2	99.93	100.04	100.09
τ = 3	99.89	100.00	100.05
ΔNAV	-0.11	0.00	0.05

Source: Staff calculation
Note: (*) indicates the day when a one-time redemption shock occurs.
$\Delta NAV = NAV_{\tau=3} - NAV_{\tau=-1}$.

Simulated NAV paths:

On day τ = 0, NSP maintains a NAV of USD 100, whereas SP's NAV drops to USD 98, and USD 97, for factor values of 2 and 3 percent, respectively. Over the next three days, NSP

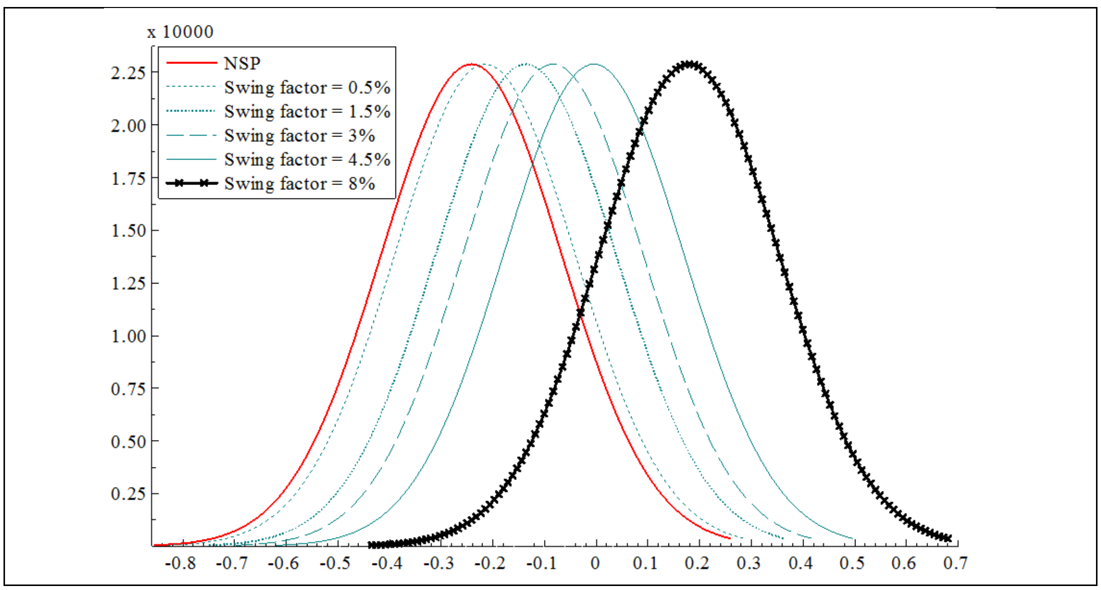
[15] The 2 percent trading cost considered here exceeds the value of the bid-offer spread typically observed in the U.S. high yield market during normal periods; which tends to hover around 1 percent for most bonds. For illustrative purposes, our example attempts to reflect higher transaction costs potentially due to market stress.

losses about 3-4 cents daily, to end up with a NAV of USD 99.89 by $\tau = 3$. SP moves to a NAV of USD 98 (factor = 2 percent) on $\tau = 0$. On $\tau = 1$, it regains all of its NAV reduction due to swing application, plus the portion of trading costs that were not incurred on $\tau = 0$. Over the following two days, this fund also incurs further trading costs while adjusting its portfolio through asset liquidations, to end up at a NAV of USD 100 by $\tau = 3$. Since trading costs were assumed to be 2 percent of the value of redemptions, the redeeming investors fully reimbursed the remaining investors for the trading costs caused by their redemption activity. If SP used a 3 percent factor, exceeding the assumed 2 percent trading costs, the redeeming investors overcompensate the remaining investors by 5 cents per share.[16] An alternative simulation with slightly higher costs, amounting to 2.5 percent of the value of redemptions is provided in Annex, Table B0.

Simulated returns for random trading cost shocks:

Trading costs will differ depending on illiquidity prevalent in the market. Within the same set-up, it is illustrated how different trading costs shocks would impact the magnitude of SP returns, given by ΔNAV (= $NAV_{\tau=3} - NAV_{\tau=-1}$). Trading cost shocks are drawn from a Gaussian distribution, constrained over support 1.0 – 10.0 percent. Figure 1 plots histograms of returns, under alternative swing factor scenarios.[17]

Figure 1. Histograms for Simulated Returns, Conditional on Different Trading Costs



Sources: Staff calculations

Notes: Trading costs shocks drawn from Gaussian distrbution constrained over range, 1.0-10.0 percent. The x-axis denotes returns. Returns are generated by 100000, simulated NAV paths for each swing factor calibration.

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16 In should be noted that equal amounts by which costs accrue to funds over τ = 1, 2, and 3, is a simplifying assumption to aid our exposition. This can be relaxed to allow for a stochastic process driving costs. Restricting the time periods to say, τ = -1, 0 and 1, would not alter the overall prediction of the SP fund's NAV reverting to, or overshooting baseline NAV (= 100).

17 We report a continuous interpolation of generated histograms, using a Gaussian kernel.

The main stylized results, S1 and S2, from our simulations, are summarized in Table 2.

Table 2. Simulation Excercise: Main Stylized Predicitions

	Prediction	Details
S1.	Over multiple periods, the aggreate NAV decline for SP, following intial an redemption shock, is smaller in magnitude compared to NSP.	Compared to NSP, the NAV path followed by SP tends to revert at a faster rate towards the basline/pre-redemption NAV (= USD 100). As reported in Table 1, $\Delta NAV_{NSP} < \Delta NAV_{SP.}$
S2.	Implementing higher swing factors increases the likelihood of observing non-negative returns, for a range of trading costs shocks.	Figure 1 indicates that average returns observed for NSP are negative, conditional on different trading cost shocks. Within our purely illustrative set up, a factor of 4.5 percent corresponds to median returns of zero. Overall, $\Delta NAV \rightarrow +\infty$, as swing factor $\rightarrow +\infty$.

III. Some Open Issues In Swing Pricing

Before turning to our empirical analysis, in this section we briefly discuss two issues of current relevance for the practice of swing pricing. Specifically, these relate to investor protection, and the SEC's recent permission for implementing swing pricing in the U.S.

A. Investor Protection

As it currently stands, monitoring biases in swing parameters is difficult given non-, or partial-disclosure of parameters. Moreover, relevant methodological details on how these are precisely quantified are also typically unclear, or unavailable. In such situations, it may be possible for managers to extract payments from redeeming investors—which are effectively 'rents'—by setting swing factors which are significantly higher than those warranted by relevant trading costs. However, we do note that it is becoming increasingly common for asset managers to set caps on the factor—amounts of which are publicly disclosed. This upper limit on the factor due to the capping can serve to manage investors' expectations, at least regarding the maximum impact on the daily NAV.

Whereas fund managers are now increasingly beginning to disclose factor information, current practice is to leave threshold levels undisclosed. The widely-cited reason for this is that if the precise threshold were known ex ante, investors could attempt to arbitrage and trade just under it over a number of days, detrimental to fund performance. However, we point out that fund returns can be mechanically enhanced by increasing the frequency of swing pricing, i.e., by setting very low thresholds**.** From a regulator's perspective, non-disclosure of thresholds renders it problematic to disentangle whether frequent instances of swing pricing were justified due to market conditions; or whether they were triggered by unreasonably low thresholds, set primarily to boost returns in otherwise poorly performing funds.

B. To Swing or Not to Swing: The U.S. Case

The SEC has very recently, in October 2016, permitted implementation of swing pricing in the U.S.[18] However, in contrast to Europe, numerous operational impediments for effective implementation of the tool are prevalent. Successful implementation of swing pricing in Europe is a result of its specific fund operational and distributional infrastructures. In general, this enables UCITS-eligible funds domiciled in many European jurisdictions to gather relevant information on daily trade flows—on the basis of which the decision to implement swing pricing will be made—in a timely manner, prior to the time of end-of-day NAV calculations.

Relative to their European counterparts, funds in the U.S. are notably less directly linked to their intermediaries.[19] The result is a more complex and lengthy communications processes from the time of order reception by the intermediary, until it is relayed at the fund. In Europe, the majority of trade flow information is provided more quickly to the fund from a closely associated service provider, typically before the NAV is calculated. In comparison to the U.S., swing pricing in Europe is facilitated by funds having a relatively extended period between trading cut-off, and final NAV calculation. Hence, reasonable estimates of most investor activity can thus be made and incorporated into the daily NAV calculation; thus allowing, in principle, a fairly well-informed determination of swing threshold and price. For example, in the U.S., J.P. Morgan Asset Management (JPAM) is required to accept orders until the fund is closed for valuation, i.e. 4:00 pm ET cut-off. NAVs must be submitted for publication by 6:00 pm ET. However, information on trade flows for funds transacted via intermediaries are generally not available till early morning the next day. By contrast, in Luxembourg, JPMA stops accepting orders at 2:30 pm Central European Time (CET). Trade flow estimates/cash projections are received at 5:30 pm CET, and NAVs are published at 7:15 pm CET. This timeline is sufficiently accommodative for the fund manager to analyze flow information, and determine whether to swing the NAV.

Daily NAV calculation in the U.S. is further complicated given that a significant volume of orders received by intermediaries are *share-*, and *percentage-based*, as opposed to *currency-based*. While a fund needs to obtain timely and accurate information on fund flows from intermediaries prior to disseminating its NAV, due to the prevalence of non-currency based orders, intermediaries in turn need to know the fund's NAV in order to calculate daily net flows. Basically, the current NAV is required to process such transactions, and convert them into a common unit of currency. Conversely, in Europe, share-and percentage-based orders represent a very small proportion of total orders received by intermediaries, or funds directly.

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[18] The SEC requires funds' swing pricing policies and procedures to specify the process governing the determination of swing factors and swing thresholds, and establish caps on the former, which may not exceed 2 percent of NAV per share. Such caps will have to be publicly disclosed. Final SEC rules pertaining to swing pricing are available at: https://www.sec.gov/rules/final/2016/33-10234.pdf

[19] Intermediaries include broker-dealers, banks, independent registered investment advisers, insurance companies or retirement plan administrators. They provide vital functions by marketing and selling funds, or as operational conduits for fund purchase and sale orders.

Therefore, using the previous day's NAV to obtain flow estimates, as is conventional in Europe, is believed to introduce negligible distortion when implementing swing pricing. Overall, early NAV calculation deadlines in the U.S. coupled with lengthy communications processes between funds and intermediaries poses major impediments to swing pricing implementation. Given the current set up, U.S. mutual funds cannot access necessary information on fund flows until after NAVs have been calculated. Generic differences related to communication deadlines between the U.S. and Europe are summarized in Annex, Table B1. Significant changes would be required in the U.S. fund infrastructure to allow for effective implementation of swing pricing. So far, the SEC has only estimated compliance costs, i.e., of developing, changing, and implementing procedures related to swing pricing. These encompass a one-time cost of USD 296 million, and a recurring cost of USD 34 million. These amounts do not, however, include the one-time costs of modifying operational and IT infrastructures necessary to facilitate swing pricing. These infrastructures have evolved over several decades, covering numerous service providers, often operating in an interrelated manner.[20] Such costs would likely reach several billions of dollars, with a transition period estimated to be in excess of 3 years.[21, 22]

IV. Assessing The Effectiveness Of Swing Pricing In Reducing FMA: Baseline Strategy

To reiterate, investors are more likely to try to redeem early in periods of illiquidity, given that NAV declines may occur at accelerated rates, relative to periods of adequate market liquidity. During the former periods, FMA would hence be expected to be most significant, and also when swing pricing is most likely to be used.

Under the maintained hypothesis that FMA exists in an environment where swing pricing—or an alternative liquidity management tool—is not being implemented, our empirical strategy entails investigating the extent to which the tool's implementation reduces the magnitude of redemption impact on ΔNAV, during periods of illiquidity, towards that which

[20] In their comment letter to the SEC of January 2016, the Global Association of Risk Professionals (GARP), provided the SEC with a roadmap, outlining changes to fund infrastructure needed to implement swing pricing in the U.S.

[21] In view of the investment required in order to facilitate swing pricing in the U.S., it could be useful to compare its merits with other existing liquidity management/anti-dilution tools. In Box A in the Annex, we briefly contrast swing pricing, with redemption fees.

[22] Going forward, the SEC may also need to alter some regulations if swing pricing is to be widely adopted. In their comments to the SEC, fund companies highlighted the need for legal 'safe harbor' to protect them from any legal action in case swing pricing was erroneously implemented –on any given day. Errors will always be a possibility, especially if the tool's implementation will rely on estimated flows. The highly litigious environment in the U.S. could lead to lawsuits by mutual fund shareholders who believe they have been disadvantaged by transacting at an erroneous swung price. In Europe, the regulatory environment could be described as somewhat lenient, in that it allows most details of swing pricing to be implemented by fund companies under the oversight of self-regulatory bodies.

would be expected to prevail during periods of normal market conditions. A reduction in impact magnitude due to swing implementation accords with prediction S1, in Table 2.[23]

In what follows, we will denote the 'redemption-ΔNAV' impact magnitude during illiquid periods as φ, whereas the comparable impact during normal conditions is given by δ. In the limit, effective implementation of swing pricing should seek to make investors indifferent between redeeming during normal and illiquid periods. The proposed empirical framework implies, conditional on $\varphi > \delta$, FMA diminishes as $(\varphi - \delta) \rightarrow 0$. Therefore, the hyothesis of 'no-FMA' (= effective implementation of swing pricing) corresponds to the restriction $\varphi = \delta$; which will be tested empirically.

By assessing the difference in redemption impact between normal and illiquid periods for a swing pricing fund (or funds) we attempt to uncover effectiveness of swing pricing in diminishing FMA in an absolute sense. It could be that the amplification of φ relative to δ, would have been larger in the absence of swing pricing. In order to assess the benefits of swing pricing against this counterfactual, we also compare results across swing pricing and non-swing pricing funds.[24]

A. Sample Construction

Our empirical analysis revolves around the baseline case of a long-time swinging fund, called SP, which is known to have actively implemented swing pricing for almost a decade. Specifically, this fund invests in the USD High Yield (HY) asset class.[25] For comparison, in parallel we analyze two other funds, which have never implemented swing pricing, labeled NSP-I and NSP-II, that are invested in the same asset class. In order to further facilitate a reasonably valid comparison between SP, NSP-I, and NSP-II, it was ensured that all three individual funds track the same HY benchmark, and are characterized by investment portfolios of same average credit quality (ACQ) of '*B*'; where ACQ is defined as an average of each bond's credit rating, adjusted for its relative weighting in the portfolio.[26] This ACQ level held steady over the sample span.

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[23] As demonstrated via comparison of simulated ΔNAV_{SP} and ΔNAV_{NSP}, implementation of swing pricing can be expected to reduce, and/or in some cases, completely counteract –over multiple periods –the initial NAV decline due to a redemption shock.

[24] Even if a comparison with non-swinging funds was not made, effective implementation of swing pricing corresponding to the restriction $\varphi = \delta$ being upheld, may be viewed as too stringent a requirement. But it should be noted we are testing whether the restriction is upheld in a statistical sense. Allowing for a 90 percent confidence interval for the test will of course accommodate a larger *average* wedge between φ and δ.

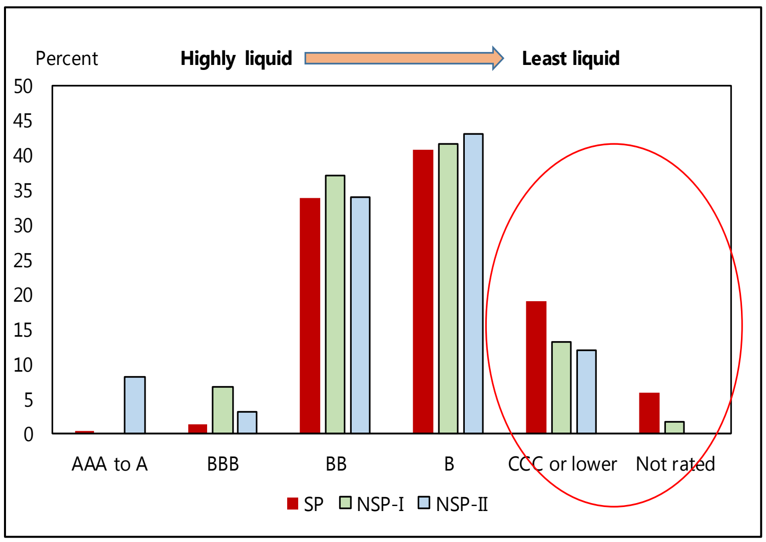
[25] Recent work by Barclays (2015), examining USD HY funds, has demonstrated that FMA can be economically significant during periods of market stress.

[26] We rely on the ACQ methodology followed by Morningstar which accounts for inherent convexity of the default rate curve. Incorporating convexity is important given default rates for corporate bonds accelerate at an increasing rate as credit quality deteriorates. A simple weighted average rating would understate the average default rate of a bond portfolio. When classifying a bond portfolio, the method first maps the 'Nationally Recognized Statistical Rating Organization credit ratings of the underlying holdings, to their respective relative default rates. Then, relative default rates (rather than grades), are averaged to determine a summary statistic for the entire portfolio. Finally, this average default rate is mapped to its corresponding credit rating along the aforementioned convex curve.

The ACQ measure is used to gauge general comparability. However, it should be noted that the least liquid segments of a fund's overall portfolio will likely witness a steeper increase in their (liquidity) risk during stress periods, relative to more liquid segments. Hence, the measure may not be a consistent gauge for comparability of funds' (portfolio) riskiness across all periods. It may be necessary to examine rating distributions of individual fund portfolios, an example of which is provided in Box 2.

Box 2. Funds' Portfolio Ratings Distributions

The figure below presents portfolio ratings distributions for SP, NSP-I and NSP-II for a given month. At this point, SP had roughly 12 percentage point more securities falling within the two riskiest, least liquid buckets – 'CCC or lower' and 'Not rated.'



Source: Morningstar Direct, Bloomberg

Implication under stress: illustrative example

Let's assume for simplicity that all three funds have almost identical holdings within each bucket, with the only sizeable difference being seen for the least liquid two. If all three funds were forced to sell 1 percent of their securities under stress proportionally across their holdings, this could result in 0.60 basis points higher trading costs for SP compared to the comparator funds. Here, 0.60 = 1 percent × 12 percent × 5 percent; where 5 percent is the assumed difference in liquidation cost between securities in the two least liquid and more liquid buckets of the portfolios. Higher trading costs for SP would translate into higher dilution, if counteracting mechanism are not in place.

All three funds are domiciled in jurisdictions which permit swing pricing, but are managed by different (large) asset managers. NSP-I has a similar retail-oriented focus as SP, while NSP-II has a relatively larger institutional investor base. Both NSPs are known to have liquidity management practices in place—other than swing pricing—which may counteract dilution and/or stabilize fund flows. These include, but are not limited to, pre-announcement of intended purchases or sales by investors, which is typically the case when end-investors are large and more institutional in nature. Pre-announcement allows fund managers to incorporate anticipated transactions within cash-flow and investment planning in a cost-minimizing way. A portfolio comprised of higher percentage of cash and high-quality/liquid securities, may also help to reduce trading costs, and as a consequence contain FMA.[27]

For the three selected funds, we compile return (r_t) and net flow ($flow_t$) data. Data are monthly, with span May 2009 to May 2016. Each month *t* in the sample, where *t* = 1,…,T, is composed of multiple trading days $\tau = 1,2,\ldots,$H.[28] Specifically, r_t is computed as the change between end, and beginning of month NAV, i.e., $\text{NAV}_{\tau=1} - \text{NAV}_{\tau=\text{H}}$, expressed a percentage of beginning of month NAV.

Net flow series is constructed as,

$$flow_t = \frac{TNA_{\tau=H} - TNA_{\tau=1}(1 + r_t)}{TNA_{\tau=1}} \times 100.$$

Here, TNA denotes total net assets. It follows that, $flow_t < 0$ corresponds to net redemptions (net outflows) from the fund.

Table 3. Defining Periods of Illiquidity

Definition	Details
A.	Periods where the VIX index exceeds its long-term average.
B.	Periods where the 1-month MOVE index exceeds its long-term average.
C.	Based on the performance of the benchmark Bank of America Merrill Lynch USD HY index; specifically, periods where benchmark returns are less than -2.0 percent.
D.	Periods where Barclay's Liquidity Cost Score for the USD HY sector exceeds its historical median.

Sources: Bloomberg, Barclays Research, FRED, Staff calculations

Notes: Periods refer to months.

Next we need to define periods of illiquidity. For purposes of this analysis, we restrict attention to four definitions, listed in Table 3. Definitions A. and B. have been employed in the literature by Goldstein et. al. (2016). Definition C. is introduced to encompass sector-specific stress. Given the benchmark-centric nature of fund investment strategies, one can expect similar redemption pressures across the three funds to ensue as a result. Similar to C., definition D. also restricts attention to the USD HY sector, but since it is based on the

[27] Some alternative strategies may only be effective in normal, or at the most moderately stressed periods. Once net-redemptions have exceeded the buffers of cash and liquid securities of the fund, FMA could become relevant even for such a more conservatively managed fund.

[28] The value of 'H' while being allowed to vary across different months, always references the last day of the month.

Liquidity Cost Score (LCS), periods of illiquidity are more explicitly defined.[29] It should be noted that the LCS follows quite closely the evolution of bid-ask spreads in the HY sector.

B. Regression Framework

The following regression is formulated in order to estimate the redemption impact on returns during periods of normal and illiquid market conditions.[30]

$$r_t = \alpha + \delta \times \{ flow_t \times I(flow_t < 0) \times (1 - I_{Illiquid}(.)) \} + \varphi \times \{ flow_t \times I(flow_t < 0) \times I_{Illiquid}(.) \} + \Theta \times \text{controls} + \xi_t \qquad \text{-- } (\mathbf{R})$$

Here, $I(flow_t < 0)$ is an indicator function, taking the value of unity when net-redemptions are witnessed over the month. Hence, the coefficients δ, and φ, correspond specifically to the impact of redemptions on returns, during normal, and illiquid periods, respectively. The indicator function $I_{Illiquid}(.)$ refers to the following condition:

$$I_{Illiquid}(.) = \begin{cases} 1, & \text{if illiquid period definition is satisfied} \\ 0, & \text{otherwise} \end{cases}$$

The control variables included in the regression are: $flow_t$, r_{t-1}, and $\log(TNA_{\tau=1})$.

Within the above framework, the hypothesis of 'no-FMA' entails testing whether the restriction δ = φ, is upheld, statistically. Our proposed strategy gauges where φ is located in relation to $\pm$ 2 standard errors of δ. The upper limit of this confidence interval for δ corresponds to the boundary of what we refer to as the 'no-FMA' region.

Given our regression specification, possible endogeneity bias due to reverse causality between returns and flows cannot be ruled out. However, in what follows, we shall argue for, and demonstrate, robustness of results to potential bias.[31]

C. Empirical Results

Results comparing impact coefficients, φ, for SP, NSP-I and NSP-II, relative to their specific 'no-FMA' regions are plotted in Figure 2. Specifically, φ measures the percentage point decline in returns, for one percentage point increase in redemptions. Results for the swinging fund suggests that for all illiquidity defintions, with the exception of B., the hypothesis of no significant FMA cannot be upheld. This goes against what we would expect, assuming swing

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[29] LCS series is sourced from Barclays Research.

[30] Our proposed framework loosely relates to what has recently been put forth in Goldstein et al. (2016).

[31] The percentage of redemption events observed in sample, conditional on different illiquidity definitions, are provided in the Annex, Figure A1.

pricing was indeed effective in reducing FMA. All OLS estimations of equation (R) employ heteroskedasticity and autocorrelation consistent standard errors.[32]

The coefficients φ corresponding to NSP-I and -II appear to be smaller in magnitude relative to SP. Moreover, they are closer to, and in some cases, within their no-FMA boundaries. It is conceivable that specific portfolio compositions of NSPs and/or alternative liquidity management strategies employed, may have been more effective in counteracting FMA over the sample, compared with swing pricing – as implemented by SP. We return to this aspect later in Section VII.

To check the robustness of our results, the above analysis is re-run with two modifications. Firstly, in accordance with some parts of the literature, our regression is estimated using flows winsorized at the 5 percent and 95 percent levels.[33] This should remove any bias in inference due to extreme outliers. Secondly, we try to account for possible endogeneity bias which may be present due to reverse causality between returns and flows.

The standard practice of using instrumental variables to address endogeneity is infeasible given lack of valid instruments for flows (Remolona et al., 1997). While intuitively we feel the postulated direction of causality from flows to returns is reasonable, we consider an alternative specification for equation (R) in order to assess result sensitivity to possible endogeneity. Our approach entails replacement of contemporaneous returns, with two-month aggregate returns, $r_t^{1+}(= r_t + r_{t+1})$. Since r_t^{1+} encompasses leading information, relative to timing of the explanatory variables, there can be no reverse causality – by construction. Any potential bias induced by overlapping observations when using r_t^{1+} is not a concern, as long as $r_t \sim \text{i.i.d.}$; see Brittan-Jones and Neuberger (2011). This condition is verified via estimated autocorrelation functions for returns, presented in Annex, Figure A2. Results accounting for the aforementioned checks are plotted in Annex, Figure A3. We find that both winsorization, and modification of equation (R) to circumvent endogeneity, leave our initial conclusions qualitatively unchanged.

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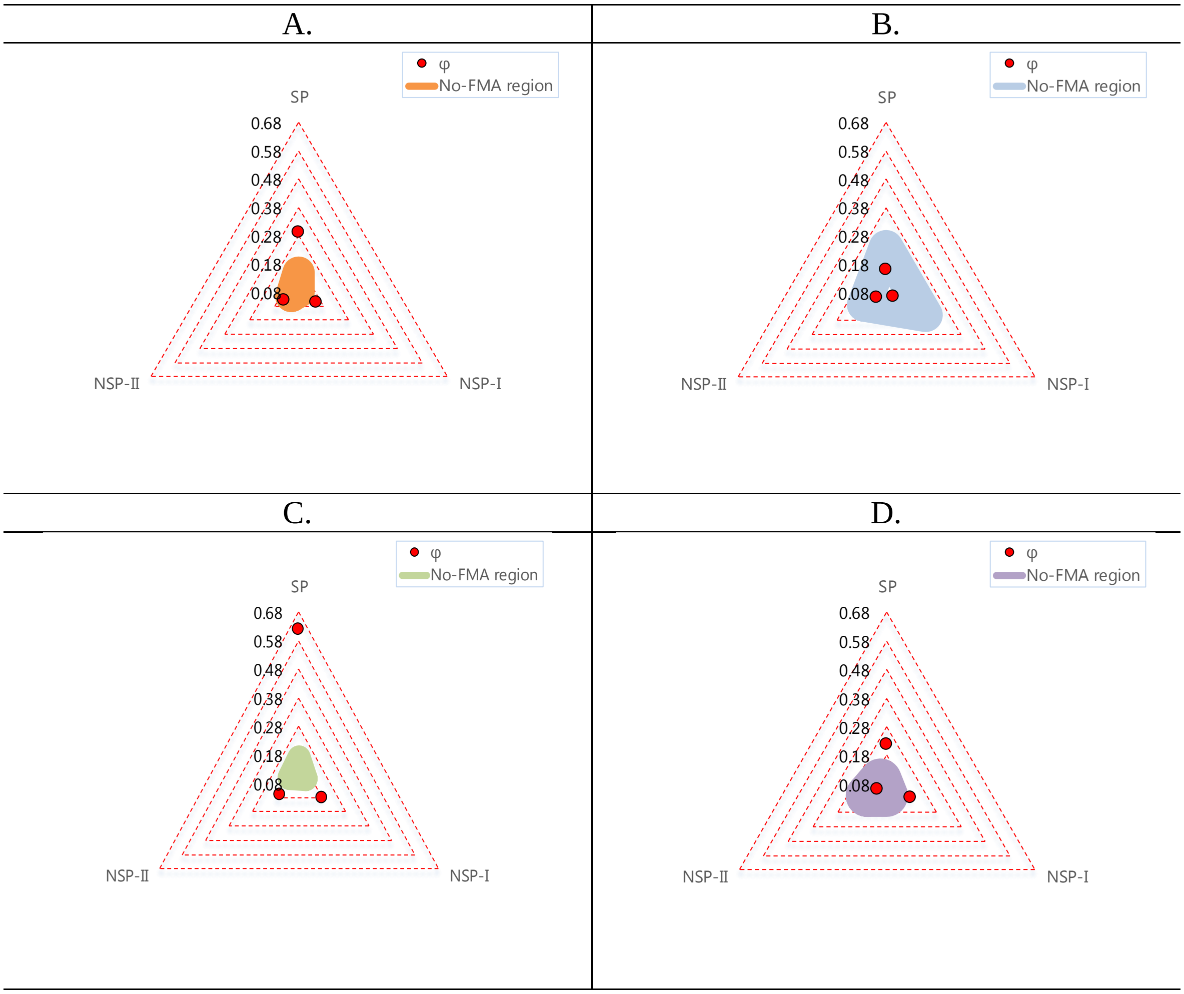
[32] Regression results underlying Figure 2, are provided in the Annex, Table B2. It should be noted that the restriction can be tested via a Wald test. The reason we chose to go down the route described is because, for our purposes, we require information not just on whether the restriction is statistically upheld or not, but also the magnitude of wedge between the impact coefficients. A simultaneous assessment of both these aspects, we felt was best accomplished graphically, using the scheme outlined. Results for Wald tests are, however, are reported in the Annex, Table B3.

[33] Winsorizing entails replacement of extreme values in the data series with a certain percentile value from each end of the empirical distribution.

Figure 2. Uncovering Evidence of FMA Under Alternative Illiquid Period Definitions



Sources: Morningstar Direct, Barclays Research, Bloomberg, FRED, Staff calculations
Notes: Results based on estimation of equation (R). The impact coefficient φ measures the percentage point decline in fund returns, for a one percentage point increase in redemptions, during illiquid periods. The boundary of the non-FMA region corresponds upper limit of ± 2 standard error confidence interval for δ. Illiquid period definitions, A. B. C. and D., are provided in Table 3.

D. Evidence of FMA in an Alternative Asset Class

To recall, within our framework, evidence of the degree of FMA present for a fund is based on the relative amplification of φ over δ. This would imply that NSP-I and -II are characterized by a lesser degree of FMA, as compared to SP. However, this result cannot be generalized to other non-swinging funds, invested in other asset classes, and/or managed by different asset managers. Therefore, we now consider a swinging fund, and a non-swinging fund, invested in an asset class other than USD HY. Asset managers, managing SP and NSP-II considered previously, were also found to manage funds invested in the Global HY asset class, in base currency USD. We re-run our analysis using data on a swinging Global HY fund (SP-GL), and non-swinging fund (NSP-II-GL).[34] The data span used, and considerations guiding our sample construction remain the same as outlined in for SP, NSP-I and -II.

Results summarized in Table 4 suggest evidence of FMA in both SP-GL and NSP-II-GL. Moreover, the ratio of φ to δ (average across all illiquidity definitions) for the latter is 5.4, as opposed to 3.5 for the SP-GL. This indicates that, in contrast to USD HY, for this particular asset class, the non-swinging fund is characterized by a degree of FMA exceeding that of the comparator swinging fund, certeris paribus.

Table 4. Evidence of FMA in Global HY Asset Class

Illiquidity definition		A.	B.	C.	D.
SP-GL	φ:	0.33†	0.23†	0.27†	0.23†
	δ:	0.08	0.06	0.11	0.05
NSP-II-GL	φ:	0.35†	0.66†	0.28†	0.21†
	δ:	0.04	0.08	0.07	0.09

Sources: Morningstar Direct, Barclays Research, Bloomberg, FRED, Staff calculations

Notes: Estimates of φ and δ using equation (R). (†) indicates impact coefficients φ lie outside the no-FMA region defined by $\pm$ 2 standard errors of δ. In this example, flow data is winsorized.

V. Pooling Information Across Multiple Funds: An Attempt Towards a Generalized Result

In this section, we deviate from our previous (baseline) fund-by-fund strategy, and provide an example of FMA testing on a group of swinging funds, via panel estimation.[35] Such an estimation strategy—based on pooling information across multiple entities, in our case funds—can yield certain benefits. Specifically, it may allow us to formulate a view regarding existence of FMA, *on average*, for a given fund group, via efficient usage of available cross-sectional information, and enhance the power of FMA testing. Furthermore, panel methods facilitate incorporation of fixed effects which can help control for bias induced by omitted *unobserved* fund-specific characteristics. Such a bias may indeed be prevalent in a fund-by-fund estimation strategy.

A. Data Sample and Panel Framework

Inclusive of SP and SP-GL considered in the previous section, we were able to collect information for only six funds, that are known to have had a swing pricing mechanism in place over the entire the span of our analysis—May 2009 to May 2016. Compiling data on a

[34] Both SP-GL and NSP-II-GL are charecterized by ACQ level of '*B*.'

[35] See Wooldridge (2001) for a comprehensive overview of merits of panel techniques.

larger number of swing pricing funds was hindered by the fact that, in spite of a there being a substantial proportion of asset managers currently using swing pricing, the specific date when they started implementing the tool was found to be, in general, difficult to ascertain.[36]

All six funds happen to fall under the same asset manager, and invest in what can be very broadly defined as a 'USD-denominated global fixed-income asset class.' However, most of these funds have a distinct investment focus, geared towards corporate debt issued from a specific geographical region. Furthermore, across all six funds, investment portfolios fall within two different ACQ categories. Specifically, three of the six funds have an ACQ level of '*BB*,' whereas the other three are '*B*.'

To facilitate a panel/pooled structure, equation (R) for each fund *i*, where *i* = 1,…,N, can be stacked as below.

$$r_{i,t} = \alpha_p + \delta_p \times \{ flow_{i,t} \times I(flow_{i,t} < 0) \times (1 - I_{Illiquid}(.)) \} + \varphi_p \times \{ flow_{i,t} \times I\left(flow_{i,t} < 0\right) \times I_{Illiquid}(.) \} + ß_p \times \text{controls}_{i,t} + \xi_{i,t} \qquad \text{-- } (\mathbf{P})$$

In the empirical example considered here, N (= 6) << T, and total observations available for estimation of equation (P) are 468 (= N×T). As before, one-period lagged returns, contemporaneous flows and TNA levels (in log terms), are added as controls. In addition to assumptions on the covariance structure for $\xi_{i,t}$, some practical considerations around panel estimation in light of our specific case are discussed in in Box 3.

Similar to the strategy followed previously (in Section V), the hyothesis of 'no-FMA' in this framework entails testing whether the restriction $\delta_p = \varphi_p$, is upheld statistically. Essentially, we gauge where φ_p is located in relation to $\pm$ 2 standard errors of δ_p. The upper limit of this confidence interval for δ_p being the boundary of the 'no-FMA' region. Since our cross-section is not confined to USD HY asset class, we restrict attention to definitions A. and B. These definitions, it is felt, are more aligned with what could be considered 'broad-based' measures of market illiquidity. Indeed, the empirical finance literature has typically considered VIX and MOVE as leading proxies for general market volatility/illiquidity.

In keeping with the earlier line of enquiry, which entailed comparing across SP and NSPs for a given asset class, we would ideally want to estimate equation (P) on a control group, i.e. a cross-section of exclusively non-swinging funds. However, a reasonable comparison was found to be infeasible, given lack of data on non-swingers with similar investment focus and ACQ levels, on an individual basis, with each fund included in the swinging group.

[36] We specifically refer to asset managers with funds domiciled in Europe.

Box 3. Panel Implementation—Some Practical Considerations

While benefits of increased statistical power afforded by panel/pooling data are well-documented (see: Matyas and Sevestre, 1999 and Hsiao, 2003), it can be argued that using such an approach may not be as compelling in the case of the current application; i.e., with N quite small, and T large. In this case, each equation forming the cross-section can be reliably estimated separately, as per our fund-by-fund approach. But, if impact coefficients are identical (in a statistical sense), such that $\delta_i = \delta_p$ and $\varphi_i = \varphi_p$ for all *i*, the panel estimator will converge to these common coefficients, providing more precise estimates compared to a fund-by-fund estimation strategy. The testable hypothesis of homogeneity of slope coefficients, according to Pesaran and Smith (1995) is, however, almost always rejected by the data, even if the size of the test is adjusted to account of larger number of observations.

Given the heterogeneity across swinging funds included in our panel, it is reasonable to expect restrictions $\delta_i = \delta_p$ and $\varphi_i = \varphi_p$ to not hold. However, in this case, a panel estimation strategy may be useful, in that the estimator will essentially converge towards an 'average' of impact coefficients. Panel estimates, and related tests, thus aim to make a statement pertaining to evidence of FMA, *on average*, within a (heterogonous) panel.

In estimating (P) we will need to be decide on type of fixed-effects to included. Cross-section fixed-effects control for omitted variables that may vary across individual funds, but are constant over time. Also, given N small, as in our case, cross-section fixed-effects will be consistently estimated. Incorporating time fixed-effects is intuitively ruled out since we would not expect, based on heterogeneity in funds' investments, any unobserved changes over time, which are likely to be impacting all $r_{i,t}$ in an identical way. Moreover, time fixed-effects are inconsistent as $T \to \infty$.

Regarding assumptions on covariance structure of $\xi_{i,t}$ our estimations will employ heteroscedasticity robust standard errors, computed based on the 'panel corrected standard errors' (PCSE) methodology of Beck and Katz (1995). While both types of PCSE covariance estimators that will be used in our application, i.e., 'cross-section weights' and 'cross-section SUR,' are robust to cross-sectional heteroscedasticity, the latter variant additionally handles potential cross-sectional contemporaneous disturbance correlation (or period clustering); see also Zellner (1963). Allowance made for period clustering is on the basis of all funds falling within the same asset manager, and also located in the same domicile.

B. Estimation Results

Estimation results for (P) reported in Table 5, reveal that for our cross-section of swinging funds, there is, on average, evidence of FMA.[37] Under definition B., φ_p is located well above $+2$ standard error boundary of δ_p, across both panel corrected standard error assumptions. However, under definition A., evidence of FMA can only be upheld for the standard error assumption which does not allow for period clustering (see Box 3). These results are reflected in p-values for Wald statistics for the test $H_0: \varphi_p - \delta_p = 0$; for which we (as before) specify a 5 percent significance level.[38] Results remained qualitatively unaltered in the static case, i.e., if lagged returns were excluded from the set of controls.

Table 5. Evidence of FMA in Pooled Sample of Swinging Funds

Illiquidity definition	Pooled-OLS estimates		Panel Corrected Standard Errors: Cross-section weights	Panel Corrected Standard Errors: Cross-section SUR
A.	φ_p:	0.04§	0.02	0.03
	δ_p:	0.01	0.01	0.02
B.	φ_p:	0.12§§	0.03	0.04
	δ_p:	0.00	0.02	0.02
	Wald test		p-values: significance level 5%	
A.	$H_0: \varphi_p - \delta_p = 0$		0.048	0.097
B.	$H_0: \varphi_p - \delta_p = 0$		0.001	0.007

Sources: Morningstar Direct, Bloomberg, FRED, Staff calculations
Notes: Estimates of φ_p and δ_p using equation (P). No fixed-effects included. (§§) indicates impact coefficient φ_p lies outside the no-FMA region defined by $\pm$ 2 standard errors of δ_p, across *both* panel corrected standard error (PCSE) assumptions. PCSE computed using methodology proposed by Beck and Katz (1995). Flow data is winsorized. Included funds fall under a single asset manager.
A p-value < 0.05 would indicate rejection of null $H_0: \varphi_p - \delta_p = 0$, at a 5% siginicance level. Illiquid period definitions, A. and B. are provided in Table 3.

A potential caveat to our above estimation is a potential lack of asymptotic unbiasedness and consistency. As noted in Pesaran and Smith (1995), if regressors are serially correlated, incorrectly ignoring coefficient heterogeneity could induce serial correlation in the disturbance, thereby generating inconsistent pooled estimates if lagged dependent variables

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[37] As part of our estimation strategy, we initially ran equation (P) including cross-sectional fixed effects, and then proceeded to test for their redundancy via a Chow-type statistic. Results indicated that inclusion of cross-section fixed-effects in our case are not warranted on statistical grounds (see Annex, Table B4). Therefore, our estimator effectively reduces to pooled-OLS. In case of a pooled estimator (with no fixed-effects), one could also follow a fund-by-fund estimation strategy, and calculate the average across parameters; the resulting estimator known as the 'Mean Group Estimator.' Pesaran, Smith and Im (1996) discusses various pooled estimators for heterogeneous panels, dynamic and static, and their associated asymptotic properties.

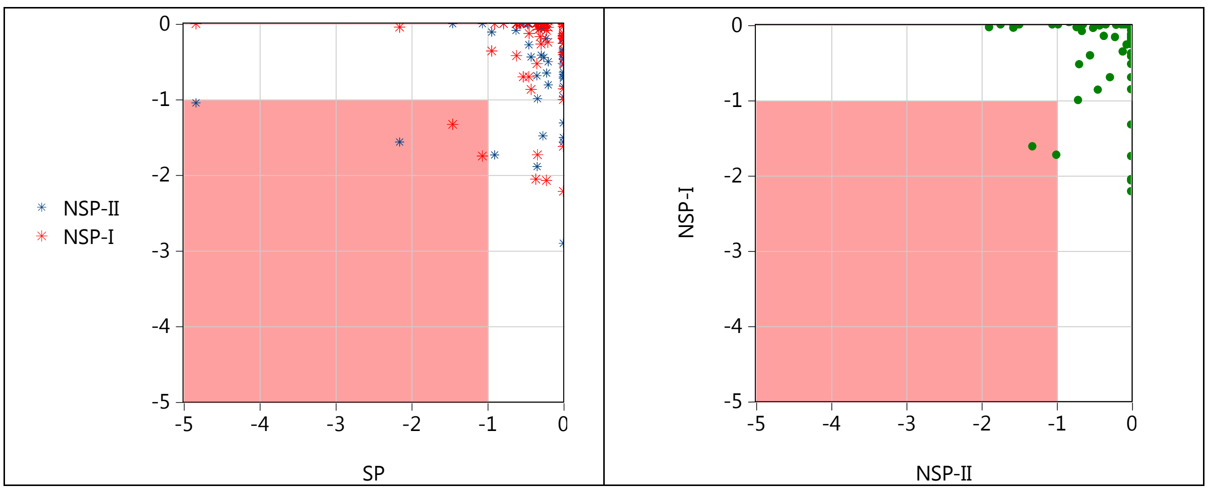
[38] The p-value is the estimated probability of incorrectly rejecting a true null hypothesis H_0. H_0 is rejected if p-value < 0.05.

are present. Assuming N large, such a problem is prevalent even if T→∞. In the case of a static panel, if we assume regressors are strictly exogenous, consistent (and unbiased) pooled estimates still require both T and N to be large.[39] So while a panel/pooling strategy could be viewed as a natural choice to enable optimal utilization of available cross-sectional information, a quite modest dimension N = 6 would still pose a limitation in estimation of both dynamic and static (heterogeneous) panels.

VI. What Might Redemption Patterns Reveal About FMA?

Tests conducted in Section IV provided evidence of FMA in SP. A primary concern around the presence of FMA is the increased likelihood of witnessing large scale, systemically destabilizing redemptions. We now proceed to analyze redemption magnitudes. In order to facilitate comparability across the three USD HY funds, and to isolate large movements relative to historical fund-specific variability, we convert flow data into standard deviation from mean form.

Figure 3. Redemption Magnitudes and Co-movement



Source: Morningstar Direct, Staff calculation
Notes: The axes denote standard deviations from mean. Shaded regions indicate co-movements in excess of one standard deviation. Time span: May 2009 to May 2016.

Over the sample span, the maximum redemption magnitude witnessed was for SP, at 4.84, compared with 2.22 for NSP-I, and 2.90 for NSP-II. Figure 3 (left panel) relates monthly redemption magnitudes for SP (on horizontal axis), to those of NSP-I and NSP-II. In two instances when moves in excess of one standard deviation were seen by SP, there were no large redemptions faced by NSP-I. On the other hand, some evidence of co-movement in sizable redemptions between SP and NSP-II is revealed. While we do not attempt to verify this formally here, it is tentatively conjectured that redemption patterns in SP may have potentially been influenced by NSP-II. Our reasoning is as follows. Whereas NSP-I is a retail-oriented fund, NSP-II is institutional. The latter tends to be populated by sophisticated,

[39] However, as discussed in Baltagi (Chapter 4: 1995), pooled estimators can yield more efficient estimates at the expense of bias, so one must therefore balance the two concerns (see Hjalmarsson, 2008).

well-informed investors, rendering it possible that retail investors in SP attempt to herd with NSP-II during times of stress, or when institutional investors redeem in large amounts. SP's investors may take this as a verification of adverse market conditions. In contrast, Figure 3 (right panel) suggests that instances of co-movements in large redemptions between NSP-I and, -II, have been comparatively less prevalent. While the conjecture of less-well informed herding with more well-informed investors may still be applicable in the NSP-I/II case; again, the liquidity management protocols put in place by NSP-I could have limited redemption magnitudes.

The expectation of amplified NAV declines, during periods of relative illiquidity, may prompt significant redemptions. As investors trade out of the fund, a decline in NAV is witnessed. This in turn leads to further rounds of redemptions, and so on. Unless counteracted, over multiple periods, the negative feedback between redemptions and NAV declines serve to magnify the cumulative effect on both variables. Based on this reasoning, we investigate the extent to which presence of FMA in the case of SP has coincided with observing extreme redemptions, in sample.

Table 6. Unconditional Skewness

	$flow_t$	r_t
SP	-0.44	-0.48
NSP-I	1.34	-0.33
NSP-II	0.53	-0.15

Sources: Morningstar Direct, Staff calculations
Note: Definitions of $flow_t$ and r_t correspond to those provided in Section IV. A.

While not a formal test, we can attempt to get a handle on the tendency for the negative feedback to kick-in by considering the distributional properties of flows, and returns.[40] Over the sample, the unconditional distributions for both these variables have exhibited negative skewness in the case of SP; see Table 6. This implies distributions with asymmetric tails extending more towards extreme negative values. The degree of asymmetry in returns due to skewness is comparatively less for NSP-I, whereas NSP-II is essentially symmetric. Amongst the three funds, only SP's flow distribution is negatively skewed - with a comparable magnitude to what is observed for its returns.

Thus, our analysis of redemption patterns, tentatively suggests that implementation of swing pricing by SP has not sufficiently alleviated pressure on investors to redeem in large amounts, i.e., in response to redemptions elsewhere in the USD HY sector.

[40] Strictly speaking, we should consider conditional distributions to assess co-skewness. This would entail testing flow and return patterns against a formal underlying joint data-generating process (DGP) capable of giving rise to extreme downward movements. We hope to develop such a framework as part of future research. We envisage the DGP taking the form of a *p*-order dynamical system, with unstable characteristic roots, i.e., lying within the unit circle.

VII. OVERVIEW OF RESULTS AND POLICY CONSIDERATIONS

On balance, results from our empirical strategies—fund-by-fund and pooled—reveal evidence of FMA in a group of long-term swinging bond funds. While this may be seen as running counter to what would be expected in the case of effective systemic risk mitigation, we caution that limited cross-sectional information renders our analysis essentially illustrative at this stage.

To reiterate, compiling data on a larger number of swing pricing funds was hindered by the fact that, in spite of a there being a sizeable proportion of asset managers currently using swing pricing, the specific date when they started applying the tool is generally difficult to ascertain. There does not exist any public database of funds using swing pricing, in addition, information on exact dates and/or frequency of implementation, is generally never divulged.

We therefore do not attempt to negate the potential merits of swing pricing in reducing FMA. On the other hand, we take our empirical results – and understanding of how swing pricing is currently being implemented across different jurisdictions – to suggest that in order for the tool to be more effective as a systemic risk mitigant, further modification of its design, and implementation, may be warranted. Using results for SP/SP-GL as a reference, some broad implications and associated considerations to improve the tool's effectiveness, can be suggested.

- *Execution of a periodic communications strategy to disseminate relevant information on swing pricing mechanics, and ex-post details on implementation*

That SP, in our illustration witnessed large scale redemptions, may have been because investors lacked awareness of the anti-dilution mechanics of swing pricing. Hence, regulatory authorities should require swinging funds to periodically disseminate relevant information on swing pricing mechanics, and ex-post details on implementation, for a given period. This would aid in mitigating FMA by: (i) educating investors on the anti-dilution benefits of swing pricing; and (ii) reinforcing any possible deterrent effect, as investors may not fully appreciate how implementation could penalize large redemptions. Periodic alerts containing information on factors applicable to different swinging funds, and which funds were swung over a certain period, would serve to reinforce investors' abilities to make informed decisions regarding costs and benefits of large-scale redemptions. Importantly, to minimize signal distortion, we propose that the outlined communications strategy be free-standing from prospectuses.

- *Re-calibration of swing parameters to prevent destabilizing redemptions*

It must be borne in mind that the primary function of swing pricing from the perspective of a fund manager is liquidity management/anti-dilution. Employing the tool to mitigate FMA will require swing parameters to be calibrated accordingly. As demonstrated by our simulations (prediction S2, in Table 2), fund returns are inflated as the swing factor is increased. It therefore may be the case that, in order to achieve a significant containment of FMA, a higher swing factor may have to be applied. It is also conceivable that to counteract incentives for investors to redeem in large amounts, this factor should be high enough to act as a sufficient deterrent.

Such a re-calibration may entail setting factors which are significantly higher than those justified by prevailing trading costs. So while enhancement of the swing factor in order to deter destabilizing redemptions may be justified from a systemic risk mitigation perspective, the steeper penalty for redeeming investors is potentially detrimental from an investor protection standpoint. Setting an extremely high factor across all time periods could very well be perceived as 'gating.' In addition to making the fund less attractive to new investors, this may make (depending on jurisdiction) the fund management company vulnerable to legal challenges from existing investors. However, dynamic adjustment of factors upwards, only in periods of significant market stress, could be considered. Such a 'state-contingent' adjustment could be made a mandatory requirement by authorities.

- *Enhancement of regulatory disclosure of swing parameters*

Funds domiciled in Europe and using swing pricing, do not typically disclose information on swing threshold levels. The reason widely cited is that such disclosure may raise risks of potential gaming by investors, adversely affecting fund performance. We suggest rather that funds should disclose information on threshold levels, factors, methodologies used to calculate these parameters, and periods of swing implementation, to regulatory authorities (if not to investors).[41]

From an investor protection perspective, such regulatory disclosure will serve to minimize risk of abuse. If authorities consider swing pricing as a systemic risk mitigant, such disclosure, in conjunction with daily fund flow data, will provide relevant information by which to: (i) monitor (over time) effectiveness of swing pricing in preventing large/destabilizing redemptions; and (ii) ascertain optimal limits for industry-wide swing parameters – which need not be constant across normal and stress periods.

VIII. Conclusion

Runs on open-ended mutual funds have historically been considered extreme, tail-events. However, currently prevailing market conditions of low, and declining liquidity, in corporate bond markets, coupled with a surge in fund ownership of corporate bonds, have raised systemic risk concerns.[42] In turn, the need to develop risk management tools, and introduce new regulations to address these concerns, has also intensified (FSB, 2016).

Amongst numerous regulatory bodies, swing pricing has gained popularity as a liquidity management tool, with potentially attractive systemic risk mitigation properties. However, while swing pricing has been implemented by fund managers in many jurisdictions (notably outside the U.S.), since as far back as 2009, no empirical investigation into its potential

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[41] In Box B (Annex), we describe an exercise trying to impute swing parameters, using only publicly available data. Possible impact of swing pricing on NAV volatility is also demonstrated.

[42] See GFSR (Chapter 2: October, 2015) for an examination of factors –structural and cyclical –influencing the level and resilience of market liquidity.

effectiveness as a systemic risk mitigant has ever been pursued. This paper is an initial attempt at plugging this gap, both methodologically, and empirically. From a prudential perspective, a primary reason for carrying out an assessment of historical effectiveness of the tool is to guide appropriate calibration of swing parameters going forward, so as to achieve systemic risk mitigation objectives.

While our empirical analysis is intended to be essentially illustrative (at this juncture), we take our results, and reading of the recent literature on swing pricing implementation, to provide broad directions for policy. Considerations provided in the paper –enhanced regulatory disclosure, and targeted communication of swing pricing mechanics –are aimed at enhancing the tool's effectiveness as a systemic risk mitigant. However, we note that significant trade-offs may exist in swing parameter calibration, such that objectives of systemic risk mitigation and investor protection are simultaneously satisfied.

The findings and analysis presented in this paper open a number of possible avenues for further research, which we are pursuing. In view of the non-trivial infrastructural changes required in the U.S. to facilitate swing pricing, we suggest that understanding the tool's value from a systemic risk mitigation perspective—as attempted in this paper—could be useful. Costs and benefits of adopting swing pricing should be weighed against other liquidity management tools, currently supported by the existing infrastructure, e.g., redemption fees, or gates. We will undertake such a comparative empirical analysis going forward.

Furthermore, in shifting focus away from analyzing as long a back-run of data as possible—the strategy pursued in this paper—we aim to compile data on a larger cross-section of swinging bond funds, with variable time-series lengths. Empirical testing of FMA will be thus be conducted on an unbalanced panel, with dimensions $N \geq T$. Results across different estimators, e.g., Mean Group Estimator, and Pooled Mean Group Estimator (Pesaran, Smith and Shin, 1999), will also be compared. In addition, we intend to investigate evidence of FMA within a panel of swinging equity funds.

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ANNEX

Table B0. Impact of Swinging on NAV Paths

Time	NSP	SP	
		Swing factor	
		2 percent	3 percent
τ =-1	100.00	100.00	100.00
τ = 0 *	100.00	98.00	97.00
τ = 1	99.96	100.06	100.11
τ = 2	99.91	100.02	100.07
τ = 3	99.87	99.97	100.03
ΔNAV	-0.13	-0.03	0.03

Source: Staff calculation

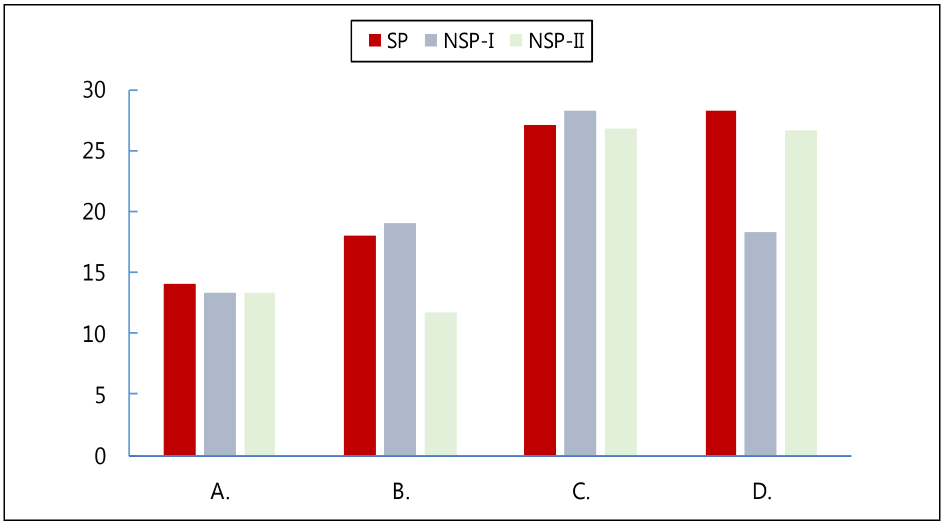
Note: Trading costs assumed 2.5%. (*) indicates the day when a one-time redemption shock occurs. $\Delta NAV = NAV_{\tau=3} - NAV_{\tau=-1}$.

Table B1. Generic Operational Differences Between European and U.S. Fund Industries

	Europe	U.S.
Role of intermediaries (1)	**2:00 pm CET – 4:00 pm CET** Estimated net flows based on prior day's NAV provided to funds.	**N/A** Intermediary systems currently do not provide estimates of net flows to funds. They require the current day NAV to process the day's transactions. Some mutual funds may have developed a process with their transfer agents to receive intraday order flow information. Although generally these data reflect only activity from investors that place orders directly with transfer agents, and would exclude, nearly all of the activity from intermediary-serviced clients.
Cut-off time for receiving orders (redemptions/subscriptions)	**Different cut-off times possible, starting as early 10:00 am CET, with final cut-off time at 4:00 pm CET.** Practices for cut-off differ across jurisdictions and asset managers. For example, U.K.-domiciled funds will use the U.K. market close as a cut-off. While 4:00 pm CET specifies a cut-off for orders via SWIFT platform, earlier times may be applicable for other instruction methods, e.g. manual and intermediary instructions.	**4:00 pm ET cut-off only** This corresponds to the NYSE market closing time, applicable to orders via all channels (under SEC's Rule 22c-2). The consistent cut-off across all channels is considered central to providing support for a predominantly intermediary-based fund distributional model, and ensuring equal treatment to all investors regardless of choice of service model.
Determination of net flows by funds	**4:00 pm CET- 6:00 pm CET** Using estimated and actual flow data from intermediaries and transfer agents.	**N/A**
NAV calculation begins	**4:00 pm CET- 6:00 pm CET** This period includes the application of the swing pricing –if assessed necessary.	**4:00 pm ET**
Final NAV review and dissemination	**By 9:00 pm CET** An indicative NAV, which includes application of a swing factor, is provided to the fund manager by the fund accountant by 7:00 pm ET. Once reviewed and approved and reviewed by manager, it is released to other parties, including intermediaries before, or at (around) 9:00 pm CET.	**6:00 pm ET target – but most NAV disseminated by 8:00 pm ET** Funds attempt to complete their valuation process and publish their final NAVs by 6:00 pm ET in order to allow intermediaries to determine their NAVs. The NAVs are disseminated to funds' transfer agents, intermediary partners, and investors, between 6:00 pm and 8:00 pm ET.
Role of intermediaries (2)	**By 2:00 am CET (next day)** Complete processing of orders and transmission of final net flows to funds.	**8:00 pm ET – by 6:00 am ET (next day)** Intermediaries process individual orders and transmit final net flows to funds.

Sources: Eaton Vance, ICI, PIMCO, JP Morgan Asset Management, GARP, IMF Staff
Notes: The timing of processes is indicative only. For Europe, it applies to fund operating in the Central European time zone.

Figure A1. Redemption Events Conditional on Illiquid Periods in Sample



Sources: Morningstar Direct, Barclays Research, Bloomberg, FRED, Staff calculations
Notes: The y-axis denotes percent. Liquidity period definitions on x-axis.
Percentage events recorded given by: $100 * \sum_T I(flow_t < 0) \times I_{Illiquid}(.) / T$

Table B2. Uncovering Evidence of FMA

Illiquidity definition		A.	B.	C.	D.
SP	φ:	0.29*†	0.16	0.62*†	0.23*†
		(0.11)	(0.12)	(0.18)	(0.10)
	δ:	0.09	0.10	0.09	-0.02
		(0.03)	(0.07)	(0.04)	(0.03)
NSP-I	φ:	0.15*†	0.11	0.18*†	0.13†
		(0.05)	(0.13)	(0.07)	(0.08)
	δ:	0.04	0.01	-0.17	0.02
		(0.02)	(0.21)	(0.16)	(0.04)
NSP-II	φ:	0.16*†	0.12*	0.14*†	0.10
		(0.03)	(0.03)	(0.04)	(0.05)
	δ:	0.04	0.06	-0.05	0.06
		(0.04)	(0.05)	(0.04)	(0.05)

Sources: Morningstar Direct, Barclays Research, Bloomberg, FRED, Staff calculations
Notes: The table reports estimates of φ and δ using equation (R). * denotes coefficient significance at 5% level. Standard errors reported in parantheses. † indicates impact coefficients φ lie outside the no-FMA region defined by $\pm$ 2 standard errors of δ. Estimations employ hetroscedasticity and autocorrelation consistent standard errors. Estimates for control variables are not reported here, but are available on request.

Table B3. Results of Wald Test for Restriction, $\varphi = \delta$

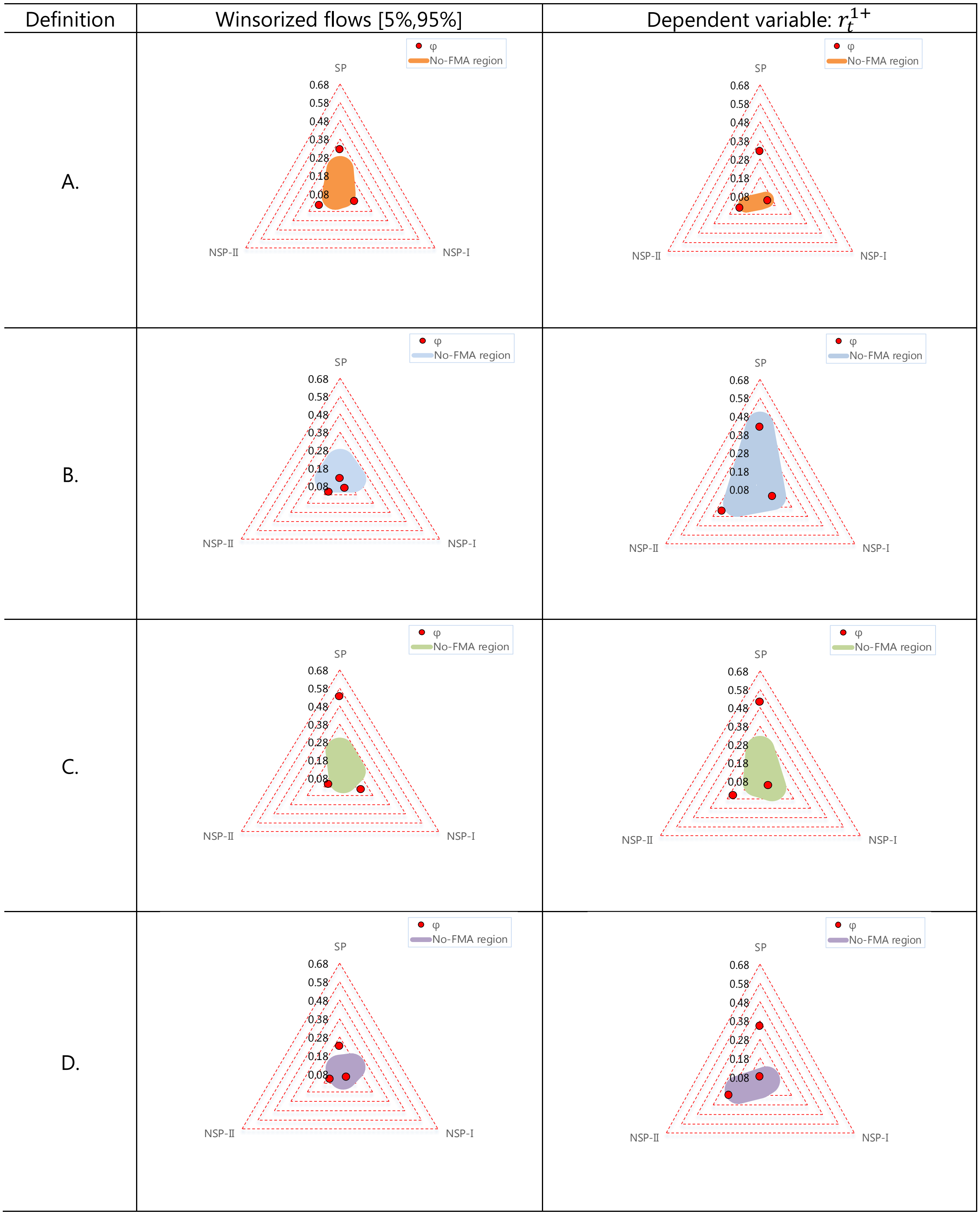
p-values for test of null hypothesis, $H_0: \varphi - \delta = 0$				
Illiquidity definition	A.	B.	C.	D.
SP	0.005§	0.102	0.000§	0.001§
NSP-I	0.021§	0.325	0.021§	0.032§
NSP-II	0.018§	0.042§	0.018§	0.052

Sources: Morningstar Direct, Barclays Research, Bloomberg, FRED, Staff calculations
Notes: § indicates a p-value < 0.05, i.e., a rejection of the null hypothesis, $\varphi = \delta$.

Figure A2. Autocorrelation Functions of Returns

Sources: Morningstar Direct, Barclays Research, Bloomberg, FRED, Staff calculations
Notes: The x-axis measures lag length. Correlation coefficients in relation to 5% significance level.

Figure A3. Uncovering Evidence of FMA—Robustness Checks



Sources: Morningstar Direct, Barclays Research, Bloomberg, FRED, Staff calculations

Notes: Results based on estimation of equation (R). The impact coefficient φ measures the percentage point decline in fund returns, for a one percentage point increase in redemptions, during illiquid periods. The boundary of the non-FMA region corresponds upper limit of ± 2 standard error confidence interval for δ.

Box A. Swing Pricing vs. Redemption Fees

Non-redeeming investors may not receive the full benefit of swing pricing, given leakages benefiting investors trading on the other side of the market, on a particular day. Essentially, the closer is the balance between outflows and inflows, the more limited will be the gains captured by the swinging fund. Given the single reported NAV for all transacting investors, those wanting to subscribe to the fund may be especially interested in doing so on days when there are expected net redemptions. Non-disclosure of swing parameters coupled with profit opportunities, brought about by artificial short-term volatility created due to swing pricing, could potentially encourage market timing behavior.[ǂ]

In contrast, redemption fees, divert all the proceeds recovered from redeeming investors to fund itself, with no benefit leaks as in the case of swing pricing. Redemption fees are fully disclosed in fund prospectuses. Also, given that benefits of fees accrue entirely to the fund risk of market timing activity are minimized. In the case of the U.S., existing operational infrastructure facilitates imposition. Within the 1940's Act, allowance in made for fund Board of Directors to impose a fee (capped at 2 percent), at the time an investor redeems, typically over a short time period post initial subscription.

However, some issues against the usage of redemption fees can be identified. Experience of several U.S. asset managers suggests that investors do *not* like paying such fees. Given a choice, most investors seem to prefer funds that do not impose fees, over funds that do. Competitive disadvantage created for funds that do impose fee may have contributed to their limited use. Moreover, while operational complexity may be less than that associated with swing pricing, effective implementation of redemption fees still requires timely assessment of information from fund intermediaries—which in practice can be prone to lags, and errors. Moreover, how redemption fees could deter FMA, to a more significant degree than swing pricing, is not entirely clear, and requires further analysis.

[ǂ] Market timing includes frequent buying and selling of shares of the same fund, or buying or selling fund shares in order to exploit inefficiencies in fund pricing. Market timing, while not illegal per se, can harm other fund investors because: (a) it can dilute the value of their shares, if the market timer is exploiting pricing inefficiencies; (b) it can disrupt the management of the fund's investment portfolio; and (c) it can cause the targeted fund to incur costs which are borne by other investors, in order to accommodate the market timer's frequent buying and selling of shares.

Table B4. Test for Fixed-effects Redundancy

		H_0: no fixed effects	
Definition		Test statistic	p-value
A.	F:	1.36	0.25
	χ^2:	5.48	0.24
B.	F:	1.13	0.34
	χ^2:	4.62	0.33

Sources: Morningstar Direct, Bloomberg, FRED, Staff calculations
Notes: Test based on including cross-section fixed effects in equation (P). It entails testing whether all of the intercept dummy variables have the same coefficient. Flow data is winsorized. A p-value < 0.05 would indicate rejection of null, at a 5% significance level.

Box B. Investigating a 'Swinger'

There is currently a lack of detailed historical information available on swing pricing parameters, and days on which it was implemented. However, we attempted to impute the swing threshold, and factor, used by one specific fund, for which the fund manager published some summary performance information. Specifically, this information included, for the span of a 1 year, the number of swing events, the fund's stated return for that period, and the portion of returns that were due to swinging the NAV. We combined this information with this fund's publicly available monthly, and daily price data, and daily data on benchmark performance.

Using the compiled information, we proceeded to identify days, during the 1-year return period, when the fund out-, or underperformed its benchmark, by around 1 percent in absolute terms. We tentatively labeled such days as 'start' and 'end' points, respectively, of swing periods. Specifically, such a period corresponds to when we believe the fund was swung in one direction, for at least one day. For instance, on day 1 of the observation period, the fund underperformed the benchmark by 1.43 percent, while on day 4 of that period it outperformed the benchmark by 1.23 percent. We associated day 1 with the NAV having been swung downwards, while day 4 is considered a 'swing reversal' day. Moving forward in time, the NAV was swung upward on day 11, remaining in that state for another 28 trading days, and swinging back to a conventionally struck NAV on the 40th day of the period. This was done for all 246 business days for which we had compiled data.

Table T1. Comparing performance of a swung and unswung fund

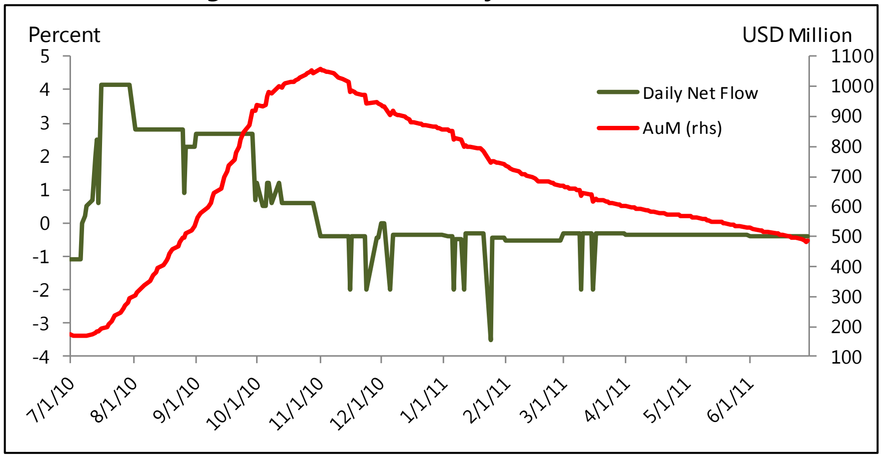
	Swung fund [a]	Unswung fund [b]	Benchmark [c]
Gross performance	7.11	4.61	7.95
Performance without swinging	4.59	4.61	7.95
Gain from swinging	2.52	-	-
Number of swing events	72	-	-
Performance benefit per swing event	3.50	-	-

Sources: Bloomberg, J. P. Morgan, Staff calculations
Notes: Figures are in percent, annualized, unless otherwise stated. [a] Net of 1.25 percent annual management expenses
[b] Based on simulations. [c] The compounded returns are based on the ending price of day 1 of the performance period, in lir
with the manager's reporting.

We were able to exactly match the 72 swing events reported by the fund manager for the period via this procedure. In addition, we calibrated daily portfolio flows (on a percentage basis), such that the calibrated numbers, together with the actual daily returns, matched the month-end AuM the fund had reported. Assuming a swing threshold of 1 percent, and applying a swing factor of 1.25 percent, our simulated gain from swinging for the year was found to be 2 basis points (bps) below what the manager had reported—i.e. 2.50 versus 2.52 percent (Table T1). After performance fees, but including the benefit from swinging, the swung fund underperformed the benchmark by 84 bps; whereas the same fund, unswung, would have underperformed by 334 bps—a considerable difference.

The fairly high incidence of swing events—72 in total—with 58 corresponding to high net inflows, and 14 to net outflows, suggests the fund grew quite rapidly. Our simulated AuM series reveals an expansion in the fund from, USD 176 million at the start of the series, to USD 1,056 million 4 months later, mainly due to inflows (Figure T). All 58 swing events to the upside took place during those first four months of the considered span. The simulated inflows were found to be in the 2 to 4 percent range, over multiple days. Tentatively, this may suggest that investors may not have been aware of the presence of swing pricing, or cared little about it. Over the remaining eight months of the span, the fund's AuM fell to USD 485 million, largely due to outflows.

Figure T. Simulated Daily Flows and AuM



Sources: Bloomberg; Staff calculations
Note: The fund's NAV was swung with a threshold of 1 percent, and a swing factor of 1.25 percent.

Table T2. Summary statistics: returns

	Swung fund [a]	Unswung fund [b]	Benchmark [c]
Daily data			
Performance	5.90	3.20	7.87
Standard deviation	8.14	3.18	2.98
Monthly data			
Performance	5.58	3.18	7.76
Standard deviation	4.85	4.34	3.97

Sources: Bloomberg, J. P. Morgan, Staff calculations
Notes: Figures are in percent, annualized, unless otherwise stated. [a] Net of 1.25 percent annual management expenses
[b] Based on simulations. [c] Based on end-of -period returns.

Returns based on swung NAVs, markedly change the typically used summary statistics such as the arithmetic mean, and the standard deviation; see Table T2. Based on daily data, the swung fund's standard deviation of returns is more than 250 percent of the standard deviation of the unswung fund. It is noted that in moving from daily to monthly data, the arithmetic mean of the swung returns declines by 31 bps, while the standard deviation declines by 329 bps. The presumption that swing pricing may lead to increased return volatility is borne out this example.