AN EXTRAORDINARY WEEK:
Shared Experiences from Inside the Fund Accounting System Failure of 2015

A Barrington Partners White Paper

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Barrington Partners
Advising Investment Managers Since 1995

INTRODUCTION: The US mutual fund industry performs a complex process to determine the Net Asset Value (NAV) of each mutual fund and class in less than 4.5 hours every day the US markets are open. (The process is different in international markets; this paper only addresses the US market.) US markets close at 4:00 pm ET and NAVs are due to NASDAQ by 8.30 pm ET. However, most large intermediaries require that NAVs are submitted to them earlier. Given the intricacies of the process, it is impressive that the industry suffers few failures to deliver correct NAVs. The situation examined in this research involves the failure of an accounting system over five days, the downstream impact on fund companies and intermediaries, and how these groups handled the situation. This research also considers the differences between what firms 'think they should do' and what firms in the midst of the situation found they 'needed to do' to manage each day in an extraordinary week.

DISCLAIMER: This white paper represents a compilation of information, firsthand experiences, and thoughts prompted by the fund accounting system failure in August 2015. All comments, opinions and beliefs represented are deliberately unattributed. The objective of this research is not to find fault; instead, our goal is to provide information to fund companies that either utilize a third-party Service Provider for fund accounting or employ a third-party system to perform the fund accounting function in-house. While the delivery of fund accounting services depends both on technology and on services, this while paper does not try to distinguish between the capabilities, services or failures among the collection of firms that work together to deliver the ultimate service. This document refers to all of them together in the singular as 'Service Provider'.

This white paper juxtaposes discussions among fund groups that were not directly affected but have been appropriately focused on planning for such an event, with the firsthand experiences of other fund companies. The discussion points from both groups are a compilation of comments, thoughts and/or opinions and as such are not representative of any one individual or company. Barrington did not attempt to contact Service Providers since that is not the focus of this research. While companies that satisfy our definition of Service Provider may disagree with the events related in this document, the information in this research reflect the experiences of individuals who went through the event. The focus of this paper is to document the implications for a fund company when they lose the ability to strike an NAV over multiple days across many or all of their funds.

AUGUST 2015: In a standard operation, a patch was applied to several installations of a well-established fund accounting system on a Saturday morning. This patch already had been implemented at many other installations, and the process was considered to be fairly routine. However, for one installation the application of the patch did not work correctly. This failure did not fully corrupt the system but would severely limit its speed of operation. When the patch was applied, the back-up for the prior week had not been finished and saved separately, so the patch was inadvertently applied to both the current version of the system as well as the version for the prior week. This eliminated the option to restore the system to the Friday close before the patch was applied. If a back-up would be used (which it apparently was in the end), the restoration would need to be made to a back-up copy from a week prior to when the patch was applied.

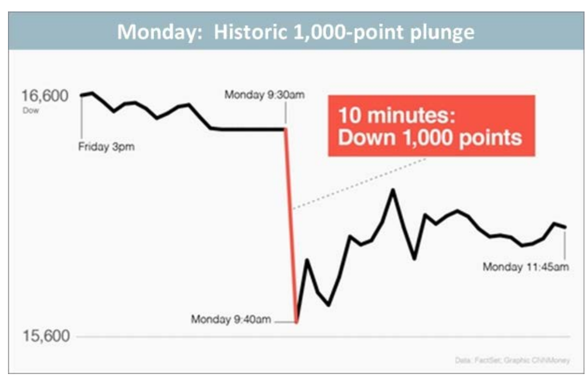
Over the weekend, further operation and testing made it apparent that the system was not functioning correctly.

Monday Morning

On Monday morning clients of the Service Provider were informed that there were problems with the normal operation of the system; however, the Service Provider communicated that they believed that the system would resume normal operation before the end-of-day NAV calculation process. While not a frequent occurrence, firms utilizing this Service Provider (and any other Service Provider supporting this type of work) have received similar notices in the past. Based on a strong history of dependable system operation, the implicated fund firms were confident that the system would in fact be restored to normal operation before the close of the business day. In hindsight, the afflicted firms all commented that they lost many hours on Monday that could have been used for contingency planning. It was not until around 3-4 pm ET that, despite encouraging messages from the Service Provider, firms began to 'appreciate the gravity of the situation' they faced. These firms needed to start making plans for an end-of-day without an official NAV.

A major discussion point in this paper focuses on the most important decision that firms need to make if the Service Provider or the system is unable to produce NAVs. Should the fund company be prepared to calculate and deliver a NAV (or estimated NAV) and, if so, should that fund company deliver those NAVs to the market? Many firms that were not impacted have expressed concern that the delivery of NAVs would remove the Service Provider's legal responsibility and liability to produce official NAVs. If neither the fund company nor the Service Provider submits a NAV, the market will use the 'stale price', or the last published NAV (generally the NAV from the prior business day). This price is considered 'stale' since it does not take into consideration the current business day's activity.

An additional complicating factor was that this week of system issues coincided with a week of very volatile market activity in the equity markets (fortunately, it was a calm week in the bond market). When the markets opened Monday morning, the most commonly quoted market index dropped 1,000 points within 10 minutes. During the day the market remained volatile but generally regained some ground.



Mutual funds are priced based on the end-of-day valuation of holdings. When the market moves lower, generally the NAV for a fund will drop as well (depending on the specific holdings). In this scenario, if the prior day's NAV is relied on for purchases and/or redemptions, the number of shares sold or purchased will be incorrect. Investors buying shares will have paid more than they should for the shares since the 'stale' NAV was too high, and investors selling shares would receive more than they should due to the inaccuracy of the high 'stale' NAV. The sellers would benefit by receiving too much money, while the investors buying shares would be due money. As the market continued to experience volatility during the week, shareholders making purchases and redemptions would be impacted in both directions based on the daily movements of the market.

As mentioned, the failure of the system to return to normal operation was clear to clients by the market close. Firms that had not started contingency planning began scrambling to determine an appropriate action. Precisely because of historic system dependability, firms had not activated their contingency plan (if they had one). A further complication is the efficiency of the industry technology in calculating NAVs. Automation has reduced the number of people involved in the NAV process considerably; when the system is not operating, firms have only a fraction of the staff necessary to price their funds manually.

Most fund companies have some type of process to provide back-up and oversight to the official NAV calculation process, called a shadow. 'Shadow accounting' is used within the industry as a term to refer to an unofficial NAV calculation; as such, it is not the official books and records of the fund. If a firm has outsourced fund accounting, the Service Provider calculates the official NAV. However, there is a wide range as to the level of complexity in the Shadow NAV calculation. The complexity can range from a process just as detailed as the Service Providers to a very perfunctory benchmark comparison. Increasingly, more and more fund companies have been dropping their shadow accounting process and leaving the Service Provider responsible for the accounting function.

The level of the shadow accounting can also include or exclude various functions that impact the final price. At a high level, the NAV can be changed by purchases and redemptions, pricing of portfolio holdings, portfolio transactions, and corporate actions, as well as the expense allocation of all applicable expenses in the fund's operation (a stable number on a day-to-day basis). There is a balance between expense and the level of shadow accounting, because a more detailed and accurate process is simply more expensive. Less exact shadow accounting may produce an NAV that does not meet the standard US accepted tolerance of half a penny. (Rounding up or down, an error of over half a penny would change the NAV when calculated to 2 decimal places. While most NAV calculations are made using 4 or 6 decimal places to reduce the rounding errors, the number that is reported publically is a 2 decimal place number. If that publicly reported number is off by a penny, the NAV is incorrect.) Firms that complete a shadow accounting process may track the resulting difference against the Service Provider, providing some further guidance. However, as mentioned, the accuracy of the shadow process is reduced by market volatility. There were firms involved that did not have a shadow accounting process and were unable to provide estimated NAVs. These firms continued to use the prior Friday stale price throughout the week.

Monday Afternoon

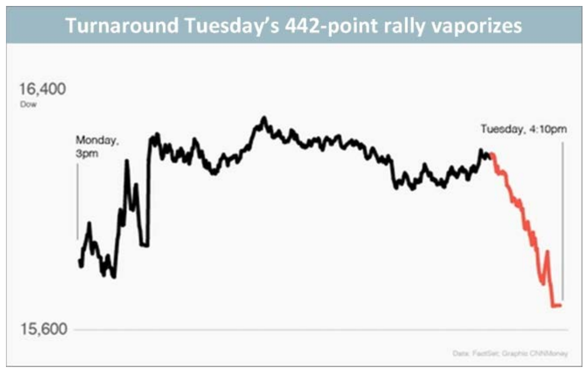
Central to decision-making on Monday afternoon was how to address the important downstream distributors of mutual funds, which are referred to as intermediaries.

Many of the large intermediaries operate omnibus accounts. These entities utilize the official NAV to calculate the actual trades in mutual funds for their customer transactions. (Fund of Funds also present a complexity since many fund of funds use proprietary funds as underlying investments. The failure to produce NAVs produced errors at both levels in a fund of funds product.) Implicated fund companies began to call intermediaries late Monday afternoon to explain the problem and discuss all-important NAV *next steps*. Should the fund company report a new (estimated) NAV, or leave the intermediary to use a ‘stale’ price. In some cases, the fund company and the intermediary agreed that a new NAV would not be submitted and that the intermediary would rely on the stale price, while in other cases fund companies decided to submit their own NAVs on Monday.

When intermediaries process transactions with an incorrect NAV (which does happen from time to time), the standard protocol is that shareholders who benefit from an error are allowed to keep the money while shareholders who were negatively impacted are made whole. While it is possible to reclaim gains from clients who did not fully pull the proceeds from their accounts, this approach is generally not pursued due to cost and impact to a client relationship. Intermediaries will reprocess transactions after the fact when there is a NAV error and they will charge the fund companies for this extra work.

Tuesday Morning

On Tuesday morning, it was clear to the afflicted fund companies that the situation had devolved. While still receiving encouraging messages from their Service Provider, these firms began to assess their ability to calculate an accurate NAV, and concurrently started talking to an increasing number of their intermediaries. Fund companies depend on intermediaries for the distribution of their fund products, and as a result need to maintain strong relationships.



In the rush of Monday afternoon, some fund companies and intermediaries decided that the fund company would not submit a new NAV, but by Tuesday the intermediaries were universally clear: they wanted a new NAV on Tuesday, even if it was not precisely accurate. Fund companies rushed to respond and organize the production of NAVs based on the systems and capabilities in place by the end of the day. Notwithstanding continued hopeful messages from the Service Provider, fund companies could easily see that the Service Provider faced a system recovery <u>and</u> would need to process two days of work in order to correctly price at the end of the day. It was at this point that fund firms felt they were in completely new territory. Firms may or may not have had a contingency plan, but none of the firms had a plan for a multiple-day total shut-down by their Service Provider over such a large number of funds. "All major decisions regarding the event had to be made on the fly. We had no plan in place for anything like this. Every time we arrived at a decision marker or ran into a roadblock, conversations/meetings among management from different departments had to be held. It was slow going, especially those first couple days."

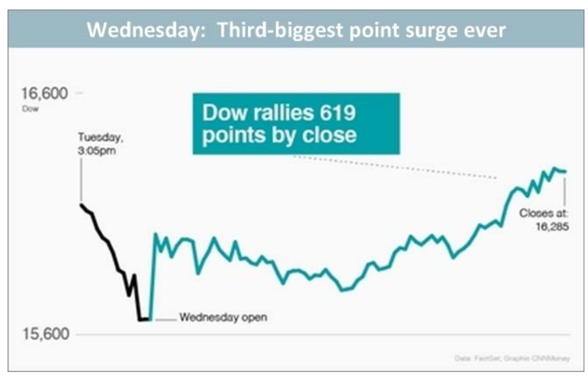
The continuing volatility of the market that week also complicated the portfolio side of the equation. The swings in stock prices make it harder to determine the underlying portfolio value based on an estimate. Benchmarking is a method that estimates the change in a portfolio based on an index and a particular fund's correlation to that index. However, this is not a perfect substitute, especially in this extraordinary situation. Time and volatility are the biggest contributors to potential errors from using this approach. This is an example of how shadow accounting is helpful to quickly check the price of a Service Provider, but is not designed to calculate the official NAV for a fund.

Another factor, shareholder activity, also played a role. Fund companies were incorporating varying percentages of shareholder activity in their NAV calculations: from no inclusion to a full accounting of shareholder activity. On a large established fund, purchases and redemptions are likely to be immaterial, but on smaller funds a large amount of daily activity could contribute to the calculation of an incorrect NAV.

On Tuesday, firms using a shadow pricing process were now comparing their calculations against the last official NAV, which was Friday of the prior week. Fund companies with a plethora of funds continued to assess the process that they would use to produce as accurate an NAV as possible. Some fund companies were moving into full NAV production mode. Fund companies used their calculated NAVs when the Service Provider failed to produce NAVs again on Tuesday. Complex products or structures provided additional problems that groups scrambled to accommodate.

Wednesday

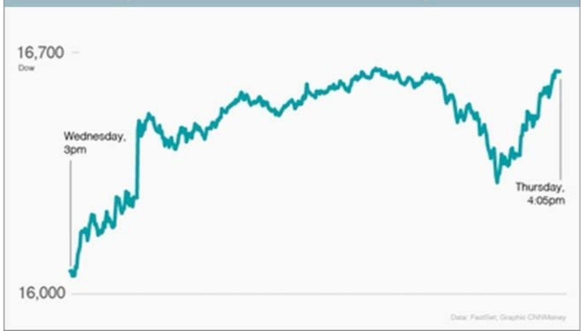
On Wednesday the market turmoil continued. The Service Provider produced manual (or estimated) NAVs for Monday.



Fund companies report being in 'full production mode' as they worked to deliver their own NAVs. Intermediaries remained adamant that they needed current NAVs, even if not totally accurate. Some intermediaries began to reprocess Monday's transactions based on the new estimated NAVs produced by the Service Provider even though their accuracy was questionable.

Thursday

On Thursday fund companies report that they continued in full NAV production mode based on the process established on Tuesday and Wednesday. The Service Provider supplied manual or estimated NAVs for the market close on Tuesday and some firms report receiving final NAVs for the Monday close. Some implicated fund companies reported that their management and staff were encouraged by the accuracy of their NAV calculations. Adrenaline induced reactions from Monday had now turned into focused determination to continue NAV production.



Thursday: Is the worst over? Rebound gains steam

Fund companies that were operating in relative isolation early in the week were now organizing conversations to discuss the various approaches being used to identify *best practices* under the circumstances. An organized call among these firms took place on Thursday and an additional call organized by the industry trade association also occurred that same day. There was no end in sight at the point of this call so fund companies expressed considerable anxiety and frustration about the situation.

Friday/Saturday

The fund accounting system experienced another failure on Thursday and an effort to rebuild the system started again. This time the system was rebuilt from the last system back-up that was not corrupted by the patch, which was one week prior to application of the patch, or nearly two weeks earlier. This version of the system was not operational until Saturday morning. As a result, on Friday the Service Provider was again not producing NAVs and fund companies supplied their own.

At this point another problem was looming: Friday was the 28th and Monday would be the last business day of the month. Any fund with a dividend scheduled for the end of the month would need to calculate a dividend at the close of business Monday. Intermediaries were again very vocal that they would need a NAV as of Monday night.

Saturday – Monday

Starting Saturday morning, the Service Provider began reprocessing work of the preceding two weeks. This work was completed between Saturday morning and Monday evening when the Service Provider provided full NAVs for the prior week and Monday.

While fund companies operated in the same mode of NAV production through Monday, the Service Provider's NAVs were delivered in sufficient time that the fund companies were able to once again use those NAVs. A full clean-up process began on Tuesday. Fully accurate NAVs were supplied to intermediaries and in many cases a second rerun of trades was completed. Fund companies recalculated their statistics with the new accurate NAVs as well. The liability to affected shareholders as calculated by both fund companies and intermediaries was then reconciled. Some companies found that their estimates were very close and that there were only small variances with the official NAVs once released. And fund companies began to make payments to intermediaries for the amounts due. The actual liability was much lower than expected.

The Service Provider reportedly rebuilt the system again the following weekend to improve stability of the system and boost speed.

AFTERMATH: Since the events of August 2015 began to emerge, it is reasonable to assume that every fund company, Service Provider and fund Board of Trustees has or is reconsidering their policies, procedures and contingency planning.

Impacted groups report that they already have or are considering putting into place a variety of practices. Most, if not all, of the following action points are applicable to all fund companies, not just those that were impacted by these events.

1. Conduct a review of Service Provider contracts, liability clauses and Service Level Agreements ('SLAs') to determine if there is a change in liability if the fund company releases its own NAV in the event that the Service Provider is unable to do so.
2. Discuss with Service Provider(s) their back-up processes. Fund companies prefer a full daily back-up to a different server than the main operating system.
3. If your firm uses a Service Provider, request documentation on their contingency plan in case their core accounting system suffers a shut-down. Review this plan with your Service Provider.
4. Does your firm have a contingency plan? Many contingency plans focus on the internal operations. However, contingency plans should also address 'critical vendors'.
5. Review the process that the fund company uses to calculate the full or shadow NAV. Maintain the daily tracking of the shadow method against the Service Provider. Additionally, firms should test their shadow rate on successive days when not compared against the official NAV.
6. Firms that do not have a shadow accounting process should perform a cost benefit analysis. Occurrences such the events described in this document are fortunately very rare. However, approaches such as suggestion #9 could provide a low cost back-up.
7. Develop an internal communications process. Information about an event such as this needs to be communicated to many areas within a fund company, which may span many locations. Staff, management, distribution, pricing committees and trustees all need to be informed about the issue in a timely manner.
8. Develop a thoughtful external communication protocol. Talking to intermediaries is critical and conversations should start early. Be aware that other vendors, the press and direct customers also may need to receive information at various intervals.
9. Develop a bespoke benchmark (or standard depending on the fund) for each fund that makes it easier

to calculate the impact of market movement.

10. While legal concerns are always raised in a situation such as this, impacted firms say that it is more important to communicate honestly with business partners like intermediaries than to let legal concerns impede constructive business communication. Firms acknowledge that legal concerns tend to win out in the planning. However, in the middle of a situation such as this one, legal concerns cannot be the first consideration.
11. Quickly reach out to other impacted firms to ascertain if they have information or approaches that may be helpful. Fund firms are considering the employment of standing instructions with Service Providers so that in the event of a failure the Provider will supply the names of other affected firms.
12. Keep your own updated copy of NAV distribution lists and contact information. Service Providers may normally be responsible for NAV distribution, and as a result they have the current list. When the fund company tried to distribute the NAVs in the situation described above, they discovered that they either had an old list or no list.
13. Put into place a plan regarding press inquiries. Have a plan and process to draft and approve a press release.
14. Prepare to have a flash website where your firm publishes NAVs for intermediaries, direct clients and other interested parties.
15. Determine how to test your Service Provider’s Disaster Recovery process. Require your Service Provider to run actual tests on a regular basis.
16. Prepare and document a contingency plan for various situations so that it can quickly be put into action. Review and update the plan at pre-determined internals. Make sure that staff understands their role and have the requisite training.

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ETF Product Issues: Although this white paper focuses on mutual funds, ETF sponsors were also impacted by the system failure described, and had to manage through their own "NAV decision-making process." However, ETFs enjoy one critical advantage over mutual funds: ETFs settle T+3 instead of T+1 (most ETFs are T+3, but not all).

Shortly after it became clear that NAVs would not be provided by the Service Provider on Monday, some ETF sponsors decided that "maintaining the ability of the Funds to trade on the exchanges was a priority over core NAV production" and "didn't want to get into the NAV estimating business". Sponsors communicated with the exchanges and regulators and found consensus to use an iNAV (indicative NAV) to continue to operate the ETF products. It was determined that the sponsor could "catch up on the NAV processing" when they had the correct numbers.

While ETF trade settlement would need an accurate NAV, this would only be an issue on T+3. Fortunately, as can be seen in the mutual fund narrative, while it was close, the T+3 timeline was never breached. Nevertheless, ETF sponsors had contingency plans for a T+3 failure that involved a plan to negotiate a delayed or estimated settlement with their ETF clients which are the APs (authorized market makers) and not retail investors. If that approach failed, sponsors were considering an alternate scenario such as using the iNAV (described as a good directional indicator) or a pricing haircut in order to settle on a later date (i.e. settling for~90%, and settling the rest later). Given the subsequent feedback from regulators and others, sponsors believe that they made the right call, "particularly as it related to not estimating NAVs".

After reviewing the experiences of mutual fund sponsors in this document, ETF sponsors commented that it "was curious to hear how influential the intermediaries were toward the decision to estimate a NAV. They were clearly driving the outcome. But when I reflect on it, from an ETF standpoint, we too were truly influenced by our form of distribution, which is the exchange trading feature. So I guess we weren't that different in that regard."

In addition to the practices mentioned in the mutual fund section, impacted ETF sponsors are considering the following:

1. Establish an 'at the ready' fail-over process.
2. Delaying trade calculations is an issue that would need to be addressed with each AP. Firms need to work with AP's in making their contingency planning. The APs were understanding and willing to work with sponsor firms, but it is a better subject to discuss in a planning process rather than a moment of crisis. Consider establishing a contingent 90% settlement protocol.

To learn more about Barrington Partners' work in the fund accounting space, please contact the authors of this white paper:

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