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Money Market Funds and Shareholder Dilution

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ABSTRACT

This paper analyzes the effects of a share valuation technique, amortized cost valuation, on institutional money market funds (MMFs) and their investors. The possibility of arbitrage between securities priced at market value and amortized MMFs is investigated. It is found that significant dilution has taken place as a result of this valuation technique. Losses per share have been about 10 basis points per year. Evidence that arbitrageurs will take advantage of a misvaluation of the MMF and cause losses to other shareholders may suggest that some investors should reconsider the desirability of amortized MMFs for their investments.

IN 1977 THE SEC approved the use of a share valuation technique, amortized cost valuation, that allows certain money market funds (MMFs) to let the reported share value of the fund deviate from its true market value. The possible danger was apparent from the start: shareholders of these MMFs would risk having their capital gains diluted by efficient arbitrageurs, who could increase their holdings of the MMF when it was undervalued and sell their shares when the MMF was overvalued. The SEC finally consented to allowing amortized cost valuation only after intense lobbying by several MMFs, and assurances from them that dilution could not occur. Today, the use of amortized cost and a close variant, penny-rounding, are used by the majority of MMFs, including those open to the general public. Yet no study to date has attempted to look at the possible harm to investors that has resulted from this valuation technique.

This paper, while limiting itself to studying institutional MMFs, finds arbitrage has taken place at significant levels. In Section I some background information on MMFs is given and their methods of valuing securities are explained. The opportunity for arbitrage with amortized cost MMFs is further explained.

Sections II and III then present empirical evidence to support the hypothesis of arbitrage and show the magnitude of these effects. In Section II it is shown that arbitrage activity may explain much of the variation in weekly asset levels of the institutional MMFs. Section III shows that the resulting dilution lowered the return to an original investor in all institutional MMFs by 10 basis points per year.

While the dilution caused by a single arbitrageur is negligible, the potential gain to an arbitrageur from a single transaction can be as large as one-half percent of the arbitrageur's investment. Given the large gains available to

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arbitrageurs, further research could investigate the possibility of arbitrage that may occur in other mutual funds. A mutual fund that owns thinly traded securities, even if valued correctly on the basis of those securities, may provide arbitrage opportunities if similar, but more actively traded, securities have changed in value.

In Section IV some concluding comments are made on the desirability of using amortized cost in light of the dilution that occurs. Amortized cost valuation may provide needed benefits to some investors, but is probably unwise for the majority of investors.

I. An Overview

Between 1976 and 1982, total assets in all MMFs grew from $4 billion to over $200 billion. This growth was fueled by interest rates on short-term money market securities that were higher than the rates banks and savings and loans could offer due to the restrictions of Regulation Q. Today, MMFs are popular with a variety of investors, including individuals, corporations, bank trust departments, and other institutions. MMFs hold diversified portfolios of commercial paper, certificates of deposit, bankers' acceptances, Eurodollar certificates of deposit, and U.S. Government securities. Small investors would not be able to purchase these instruments directly, since many instruments have minimum denominations of $100,000 and competitive rates may only be available on larger denominations. Large investors may prefer MMFs to managing their own accounts for the extra diversification, liquidity, and divisibility available from them. These investors also save on personnel, storage, and settlement expenses.[1]

In 1977 the SEC temporarily approved the use of amortized cost for institutional MMFs.[2] These MMFs were initially open only to investors with a minimum investment of $50,000. Nearly two years later, after months of hearings were held by the SEC, amortized cost was allowed on a permanent basis. Under this method the principal value of a security increases daily at a fixed rate and is unaffected by changes in market interest rates. For example, assume a security bought for $100,000 could be redeemed at maturity in six months for $105,000. This is equivalent to a simple annual interest of 10%. If this interest were thought to accrue daily, the security would increase in value by $\$100{,}000 \times 1/365 \times 10\%$ each day. The SEC requires that MMFs that elect to amortize (1) maintain a portfolio with a dollar-weighted average maturity of 120 days or less; (2) possess securities with a remaining maturity no greater than one year; and (3) monitor the deviation of the fund's reported value from its true market value. If this deviation exceeds 0.5%, the fund should consider whether stabilizing action is required.[3]

Before MMFs were allowed to use amortized cost, they were required to value their securities by the mark-to-market method. This method, as defined by the

[1] The history of MMFs and their advantages are discussed further by Cook and Duffield [1] and Dunham [4].

[2] SEC Release, no. ICA 10027, November 28, 1977.

[3] SEC Release, no. ICA 10824, August 8, 1979.

SEC, requires securities with a remaining maturity greater than 60 days to be valued at their daily market values. Securities with a remaining maturity of 60 days or less may be valued on an amortized basis.[4]

In the absence of arbitrage, the method of amortized cost leads to a more stable and predictable yield than the mark-to-market method. The yield on the amortized portfolio is a weighted moving average of past interest rates. The yield on the portfolio moves more smoothly than the current interest rate. Since interest rate changes do not affect the reported value of the fund's portfolio under amortized cost, there are no capital gains or losses to investors. In contrast, mark-to-market portfolios, which do pass on capital gains and losses, may in some periods have a negative yield if the capital loss is greater than the accrued interest.[5]

There is, however, one significant shortcoming to investors in amortized MMFs. The yield on an amortized MMF may often fluctuate above and below the current interest rate, which is the rate offered by the mark-to-market MMF. Arbitrageurs could take advantage of this and invest in amortized MMFs only when the amortized rate exceeded the current rate offered by mark-to-market MMFs or other marketed securities. These same arbitrageurs could then withdraw their investments from amortized MMFs when interest rates rose and the current market rates exceeded the yield on amortized MMFs. This nonrandom trading in amortized MMFs lowers the MMFs' average yield. These arbitrageurs dilute the capital gains of shareholders when market interest rates fall, and they magnify the capital losses of remaining shareholders when market interest rates rise.

It was argued by proponents of amortized cost valuation that many clients of MMFs, especially bank trust departments, demanded the constant share values provided by amortization or they would seek alternatives to MMFs.[6] A trust fund manager, for example, may place funds into an MMF for only a short time period and may be willing to forsake the possibility of receiving capital gains in order to be protected against a capital loss that could substantially reduce interest earnings on a short-term investment. Another reason for preferring amortized cost is that some investors operate under rules that require capital gains and losses to be separated from interest payments for accounting and tax purposes.

[4] SEC Release, no. ICA 9786, May 31, 1977. A third method of valuation, penny-rounding, used by many MMFs available to the general public, is essentially an amortized cost method. Penny-rounding, like mark-to-market, values all securities with a remaining maturity greater than 60 days at market prices, and less than 60 days on an amortized basis. Share values are computed with only a 1% accuracy. Thus, as long as the net asset value of a share stays between \$0.9950 and \$1.0050 the share value will remain \$1.00. MMFs using this method are required to maintain a dollar-weighted average maturity of 120 days or less, of which no security has a maturity longer than one year. SEC Release, no. ICA 10451, October 26, 1978.

[5] For example, if a mark-to-market fund had an average maturity of 120 days (⅓ of a year) and the interest rate rose overnight by only 1/12 of 1%, the portfolio would have a capital loss of about 1/36 of 1%. If the interest rate were 10%, this is equivalent to losing approximately one day's interest.

[6] This is noted in ICA 10451. The SEC hearings are filled with many statements such as the following: "The vast majority of institutional investors simply cannot accept the fluctuating value of the mark-to-market funds or the dramatically changing yields." Letter from Money Market Management to SEC dated March 6, 1978.

This accounting task is obviously easier in amortized cost MMFs, where there are no capital gains or losses.

A third reason investors might prefer amortized cost is if it leads to lower operating costs for the MMF and, thus, a higher net yield to the investor. This hypothesis was tested by regressing MMF expense ratios on the asset size of the MMF, its average account size, and a dummy variable for the method of valuation used by the MMF. It was found that there are significant economies of scale, and that costs fall as the average account size increases, but the method of valuation used by the MMF is not found to affect costs.[7] This may be due to the minimal cost of calculating market share values and also the fact that amortized MMFs must monitor the deviation of the fund's reported value from its market value.

Why some investors arbitrage the interest rate differential and others do not is most likely due to differences in transaction costs and risk aversion. Arbitrageurs may face low transaction costs in switching between MMFs or in self-managing their funds. Nonarbitrageurs may have smaller account sizes, so that possible gains from switching are outweighed by transaction costs, accounting and tax costs, and extra variability of yield on short-term investments.

It should be noted that these arbitrageurs tend to equalize the yield of amortized cost MMFs with market rates only when interest rates have fallen. When current rates are rising, the difference in yield is exacerbated by these traders. In this case, arbitrage out of the MMF may only be limited by the quantity of the MMF's securities maturing each day. Should investors' share redemptions exceed the quantity of cash immediately available to the MMF, the MMF reserves the right to pay the investor in kind, i.e., to pay the investor in the actual securities the MMF possesses. Shares redeemed in kind cause no further dilution since investors who withdraw funds receive their correct share of the MMF's assets.[8]

Before permanently allowing amortized cost, the SEC considered the matter for nearly two years. The SEC's concerns were over the potential dilution of MMF investments. The pioneering MMFs, which operated on a mark-to-market basis, opposed the amortized cost method being offered by the newer and initially smaller MMFs. Mark-to-market MMFs may have opposed amortized cost be-

[7] Cook and Duffield [2] first investigated MMF costs using data on 37 MMFs. Their model was adapted to test the hypothesis that amortized MMFs had lower average costs than other MMFs. MMF costs were assumed to take the following form:

$$\ln(C/A) = a + b\ln(A) + c\ln(\text{AAS}) + dV$$

where C is total costs, A is assets, AAS is average account size, and V is a dummy variable whose value is one if the MMF uses amortized cost or penny-rounding and zero otherwise. Data sources for the variables were *Wiesenberger Investment Companies Service*, 1982 edition [5], and *Donoghue's Money Fund Report* [3]. The sample consisted of 82 MMFs that were in operation for over one year and had assets greater than $100 million. The estimates are (t-statistics in parentheses):

$$\ln(C/A) = \underset{(0.46)}{-0.073} - \underset{(5.80)}{0.113}\ln(A) - \underset{(8.31)}{0.123}\ln(\text{AAS}) - \underset{(0.63)}{0.032}V, \qquad R^2 = 0.62$$

The valuation method is insignificant, while economies of scale and cost savings through larger account sizes are shown to exist.

[8] An MMF may be reluctant to redeem in kind as it is likely to damage the MMF's reputation for liquidity and draw attention to its portfolio mismanagement. The MMF may choose instead to sell its securities prematurely or borrow to meet demands for share redemption.

cause they had built their reputations on minimizing the variability of yield within the confines of the mark-to-market rules. With amortized cost they would lose their competitive advantage.[9] One mark-to-market MMF stated that it opposed amortized cost due to the problems of dilution, but would request a similar privilege if the right to amortize were granted to the other applicants. The MMF stated that without such a privilege the fund would not be able to compete with the amortized MMFs. Amortized MMFs contended that dilution would not occur because the gains from this arbitrage were small.[10] Another amortized MMF stated "institutional investors do not treat [dilution] as a consequential risk and in addition are willing to trade the opportunity for *de minimis* capital gains to obtain a stable net asset value and a reasonably predictable yield."[11]

II. Empirical Results on the Presence of Arbitrage

In this section the presence of arbitrage activity is tested for and is shown to be statistically significant. In Section III the size of the resulting dilution is estimated.

To determine when arbitrage is expected to occur, two interest rates were constructed: RMMF, the average weekly interest rate on institutional MMFs, and RP, the market interest rate of an identically composed portfolio of securities. RMMF was calculated from data provided in *Donoghue's Money Fund Report* [3], using the asset size and weekly yield for each institutional MMF. *Donoghue's Money Fund Report* also provides information on the average maturity of each MMF portfolio and the composition of the portfolio among Treasury bills, commercial paper, certificates of deposit, bankers' acceptances, overnight repurchase agreements, and Eurodollar CDs. These figures were aggregated over the

[9] Bruce Bent of Reserve Management, at the time a mark-to-market MMF, in a letter to the SEC dated February 21, 1978, states amortized cost "presents the illusion of higher returns in times of declining rates" and makes the MMF "appear to have overcome the risk" of fluctuating interest rates. He continues, "Our concern is without the discipline of having to price to market, funds valuing at amortized cost will be encouraged to acquire a significant amount of longer term obligations. Amortized cost would also permit such funds to pay higher interest rates than those which must achieve stability by exercising judgment and varying portfolio life as the market dictates." Bent states how in a period of declining interest rates old shareholders are penalized to attract new ones. He finds amortized cost "deceptive in that it leaves the impression that the performance of amortized cost funds is due to superior investment acumen rather than longer average portfolio life and accounting sleight of hand."

[10] The late Arthur M. Okun, a trustee of one MMF seeking authorization to amortize, stated during the hearings "this sharp penciled arbitrager really ought to find better opportunities in the market place." Okun may have realized that perfect arbitrage would be impossible, but underestimated the effect of many efficient portfolio managers. The most cited example of an MMF misjudging investors' responsiveness involves Institutional Liquid Assets. In the Spring of 1980 ILA expected interest rates had peaked and increased the average maturity of its portfolio to 76 days. ILA continued to hold a lengthy average maturity through August when interest rates were rising. Investors in August and September reacted by selling $648 million or 39% of the MMF's shares. In October 1980, to prevent official devaluation of the share value, the MMF's advisors returned $2 million in fees.

[11] Letter to SEC from Money Market Management dated March 6, 1978.

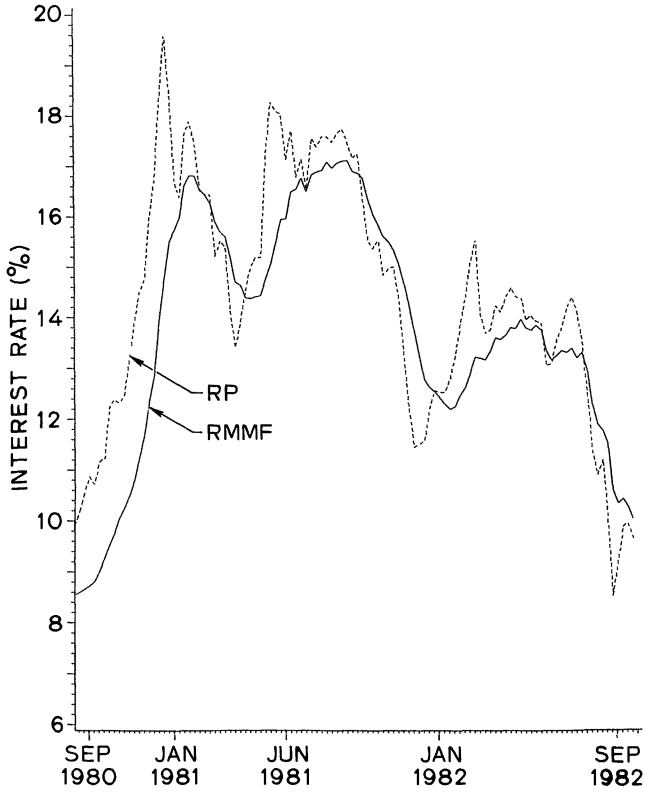

Figure 1. Comparison of Money Market Fund Yield, RMMF, with Current Yield on Competing Portfolio, RP, by Week

institutional MMFs to calculate for each week an average maturity and portfolio composition. This determines the average maturity and composition of the competing portfolio of securities. RP, the yield of this portfolio, was calculated using weekly interest rates provided by the Federal Reserve Board for the various instruments at different maturities.

Figure 1 compares the average weekly interest rate of institutional MMFs, RMMF, with the market interest rate of the portfolio of securities, RP.[12] The figure shows that amortized MMF rates do lag behind current interest rates and that many arbitrage opportunities existed over the period studied.[13]

A model of arbitrage behavior suggests investors will respond quickly to interest rate differentials. This is unlike traditional portfolio adjustment models, which often predict very slow adjustments to changes in interest rates. Thus, an initial

[12] The rate RP is not adjusted for transaction expenses, while RMMF is net of expenses. The average expense ratio for institutional MMFs was calculated to be 0.425% in 1981.

[13] The period was chosen to begin after use of MMFs had become common. Additionally, in March 1980 the Federal Reserve imposed a 15% reserve requirement on new assets of MMFs. The reserve requirement was eliminated in July 1980. Thus, August 1980 was chosen as the beginning date for the study to allow for a brief transitional period. The study period ended with the most recent data available at the time research began.

specification of arbitrage may be written as

$$\ln(\text{ASSET}_t/\text{ASSET}_{t-1}) = a + b \ln(\text{RMMF}_t/\text{RP}_t) \quad (1)$$

where ASSET is the weekly level of the institutional MMF assets. This equation states that the weekly change in MMF assets is a function of the ratio of the MMF interest rate and the interest rate of the competing portfolio of securities. The independent variable is chosen to enter as a ratio since arbitrageurs may be expected to respond to the percentage by which the MMF is misvalued. The dependent variable is also expressed as a ratio since the absolute change in assets from week to week is expected to increase with the asset level of MMFs.

This model proved to have a high degree of explanatory power and is not sensitive to changes in the specification from logs to absolute differences. For Equation (1) the estimated coefficients, after adjusting for first-order serial correlation, are (t-statistics in parentheses):

$$\ln(\text{ASSET}_t/\text{ASSET}_{t-1}) = \underset{(4.58)}{0.0140} + \underset{(6.47)}{0.1568} \ln(\text{RMMF}_t/\text{RP}_t), \qquad R^2 = 0.279 \quad (2)$$

The coefficient b is positive as expected. Arbitrage causes MMF assets to increase when $\text{RMMF}_t > \text{RP}_t$ and decrease assets when $\text{RMMF}_t < \text{RP}_t$. The coefficient a is positive, reflecting the trend in growth of the MMFs over the period.

One additional independent variable is added to the above model to account for the fact that arbitrage funds may be limited. The sensitivity to an interest rate differential in the current week is dependent on the available funds of investors. If investors arbitraged into MMFs in the previous week, less money is available this week to continue the arbitrage into MMFs and more money is available to arbitrage out of MMFs. A similar condition holds that if in the previous week investors arbitraged out of MMFs, less money is available to continue the arbitrage out of MMFs and more money is available to arbitrage into MMFs. Thus, last week's arbitrage activity can either temper or amplify this week's arbitrage activity. Since MMF shares cannot be sold short, recent arbitrage activity can be an important factor. The ratio of the previous week's interest rates on MMFs and the competing portfolio of securities is used as a proxy for that week's arbitrage activity. The estimated equation is

$$\ln(\text{ASSET}_t/\text{ASSET}_{t-1}) = a + b \ln(\text{RMMF}_t/\text{RP}_t) + c \ln(\text{RMMF}_{t-1}/\text{RP}_{t-1}) \quad (3)$$

The coefficients a and b are expected to have the same signs as they did in the previous model. The sign of c is expected to be negative. A positive interest rate differential in the previous week, for example, would dampen the effect of a positive interest rate differential this week. Similarly, a negative interest rate differential in the previous week would cause a greater response to a positive interest rate differential this week.

The resulting estimates, adjusted for first-order serial correlation, are (absolute value of t-statistics in parentheses):

$$\begin{aligned}\ln(\text{ASSET}_t/\text{ASSET}_{t-1}) = {} & \underset{(5.47)}{0.0129} + \underset{(6.67)}{0.3390} \ln(\text{RMMF}_t/\text{RP}_t) \\ & \underset{(3.96)}{-0.2016} \ln(\text{RMMF}_{t-1}/\text{RP}_{t-1}), \qquad R^2 = 0.412 \quad (4)\end{aligned}$$

All coefficients are highly significant and of the predicted sign. This model is also robust to transformations of the dependent and independent variables from logs to absolute differences.

The results of these regressions support the hypothesis that arbitrage does occur when there is a difference between the yield on MMFs and the computed yield of an identical portfolio, valued at market prices. In the absence of arbitrage opportunities, much of the weekly variation in asset levels would be eliminated.

III. The Magnitude of Dilution

The preceding evidence suggests that arbitrage of amortized MMFs may be significant. In this section estimates are made on the size of the resulting dilution.

Dilution occurs when either (1) the MMF shares are overvalued (interest rates have risen recently) and investors sell their shares of the MMF or (2) the MMF shares are undervalued (interest rates have fallen recently) and investors buy shares of the MMF. One can calculate the loss in yield from dilution in a given week by multiplying the amount the MMF share is overvalued or undervalued by the percentage change in assets from the previous week.[14]

To calculate the dilution, first all institutional MMFs were aggregated. Second, the amount by which the MMF shares are overvalued or undervalued depends, in part, on the assumed percentage service charge of the MMFs.[15] Several calculations were performed, varying the annual service charge from no charge to 1.0% of average assets, to show this sensitivity. (The average annual service charge of the institutional MMFs was 0.425% for 1981.) Third, the percentage misvaluation was multiplied by the actual change in assets to find the weekly dilution (or appreciation) of the initial shareholders' investments. Finally, this weekly figure was summed for the 109 weeks from August 17, 1980, to September 22, 1982, to give the total dilution over this period.

Table I shows the loss in yield from dilution over this period under the different service charge assumptions. The table may be explained by considering the average service charge of 0.425%. From Column 2 the total annual loss in yield over the period is found to be 0.1007% or approximately 10 basis points. Column 3 gives the amount of dilution that occurred when the MMF shares were undervalued and assets increased. This inward dilution lowered the yield by approximately 6 basis points per year. The fourth column gives the dilution that occurred when the MMF shares were overvalued and assets decreased. This outward dilution lowered the yield by almost 5 basis points. Columns 3 and 4 when summed together slightly exceed the total dilution of Column 2 because (aside from rounding error) in several weeks some appreciation in yield occurred

[14] For example, if the MMF shares are overvalued by 0.3%, and assets of the MMF fall by $10 million from a base of $200 million (5%), then the yield in that week is 0.015% (1.5 basis points) lower due to dilution. This is a loss of $30,000 in interest payments to the MMF shareholders.

[15] To calculate the percentage misvaluation, the service charge was added to the average yield of the MMF and this figure was converted into a bank discount price for the share, using the average maturity of the MMFs for the week. This bank discount price was compared with the bank discount price of the share using the computed interest rate (RP) found in Section II.

Table I

Dilution

(1) Annual Service Charge (%)	(2) Total Annual Dilution (%)	(3) Inward Dilution* (%)	(4) Outward Dilution** (%)
0.0	0.0891	0.0384	0.0654
0.25	0.0960	0.0491	0.0572
0.425	0.1007	0.0577	0.0517
0.75	0.1097	0.0762	0.0419
1.00	0.1166	0.0915	0.0353

* Inward dilution occurs if the MMF shares are undervalued and assets increase.

** Outward dilution occurs if the MMF shares are overvalued and assets decrease.

Note: Total dilution is less than the sum of inward and outward dilution. See text for explanation.

when MMF shares were overvalued and assets increased and also when MMF shares were undervalued and assets decreased.

Over the period of the study, assets of the institutional MMFs increased from $18 billion to $42 billion. Since much of this growth was likely to be exogenous with respect to arbitrage opportunities, the actual dilution that occurred may mask the dilution caused by arbitrageurs. Inward dilution is probably overestimated and outward dilution is underestimated.

The model of arbitrage behavior in Equation (3), together with the parameter estimates given in Equation (4), provide a means for estimating the amount of dilution caused solely by arbitrageurs. Here we assume that only arbitrageurs respond to the current and lagged interest rate differentials of Equation (3), while other investors are responsible for the exogenous growth in the MMFs, represented by the positive intercept term. The parameter estimates of Equation (4) allow us to calculate the weekly change in assets due to arbitrageurs.

Under these assumptions, the inward dilution caused by arbitrageurs is less than shown in Table I and the outward dilution is greater than shown in the table. Calculations performed at the different service charges confirm this result. The total dilution ranged between 10.4 and 12.3 basis points—comparable to the levels in Table I. At a service charge of 0.425%, total dilution is 10.53 basis points. Of this total, inward dilution lowered the yield by 3.85 basis points and outward dilution lowered the yield by 6.81 basis points.

The magnitude of dilution may be better understood by comparing it to the average service charge of these MMFs. An MMF could increase its service charge by 25% (10 basis points) and leave investors just as well off if it could prevent dilution.

It should be noted that interest rates during the past year have been much less volatile than during the period for which the MMF data were obtained. The coefficient of variation for weekly interest rates on three-month Treasury bills and certificates of deposit during the sample period is about 2.5 times greater

than from the conclusion of the study to March 1984. Thus, it is likely that dilution over the recent period is less than during the period of the study. Dilution, however, is not only a function of interest rate volatility, but is also dependent on the average maturity of the MMF portfolio. As the average maturity of the MMF increases, a given change in interest rates will cause a greater misvaluation of the MMF. If MMFs lengthen their portfolios to take advantage of the yield curve, some of the gains from more stable interest rates will be lost.

IV. Conclusion

The purpose of this paper has been to investigate the effect of amortized cost on institutional MMFs. The empirical results show that the resulting dilution has been significant. It may still be rational for some investors to accept minimal dilution in return for possible accounting cost savings and the short-term stability amortized cost offers. Investors should reconsider, however, whether they require an amortized MMF, given that over any interest rate cycle the mean yield on a mark-to-market MMF will equal or exceed the yield on an amortized MMF. Trust funds, which have the legal obligation to seek the highest return consistent with risk, may be hard-pressed to justify the dilution they accept in amortized MMFs. The apparent stability an investor sees in an amortized MMF could be evanescent during a prolonged period of rising or falling interest rates.

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