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The American University in Cairo

School of Business

Bad things come to those who wait:

NAV Discrepancies of Money Market Funds in Egypt

A Thesis Submitted to

The Faculty of the School of Business

The American University in Cairo

in partial fulfillment of the requirements for

the degree of Master of Science in Finance

by

Kariman Karem Kordy

Under the supervision of

Dr. Eskandar Tooma

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The American University in Cairo
School of Business
Department of Management

By
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ABSTRACT

We conduct an experiment on the Egyptian money market by testing how volatility in interest rates and asymmetric (redemption-only) structure of money market funds (MMFs) affect investors who redeem after interest rate hikes, versus those who remain in the fund. We conduct simulations on MMFs with different durations. Given current MMF accounting treatment, results show that increasing interest rates, higher redemptions than subscriptions, and longer fund durations cause unfair treatment of investors who remain in the fund after disrupted periods. The findings of this research have policy implications to regulators of MMFs in Egypt to apply a rule similar to the SEC's Rule 2a-7.

Keywords: Money Market Funds, Global Financial Crisis, Shadow Banking, Floating NAV, Fixed NAV, Accumulated Fixed NAV, Accumulated Floating NAV, Money Market Fund Reforms.

JEL Classification: G01; G14; G18

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1. Introduction

Financial markets are conventionally divided into money markets and capital markets. Whilst capital markets generally include long-term, risky securities, money markets focus on short-term, marketable, liquid, and low-risk debt instruments. As Bodie et al. (2011) noted, "Money market instruments sometimes are called cash equivalents, or just cash for short" (p. 28). The most accessible mechanism for retail investors to invest in money markets is through money market funds (MMFs), which are investment vehicles that are short term and aim at earning interest for their investors. They emerged in the late 1970s and early 1980s (Rosen & Katz 1983), during which they were considered one of the financial market's most important financial innovations. The worldwide total net assets of regulated open-ended funds had been growing over time from 2011 to 2017, which slightly fell by 5% in 2018 to reach USD 46.7 trillion. Yet MMFs continued to grow reaching USD 6.1 trillion by end of 2018 from USD 5.1 trillion in 2010.

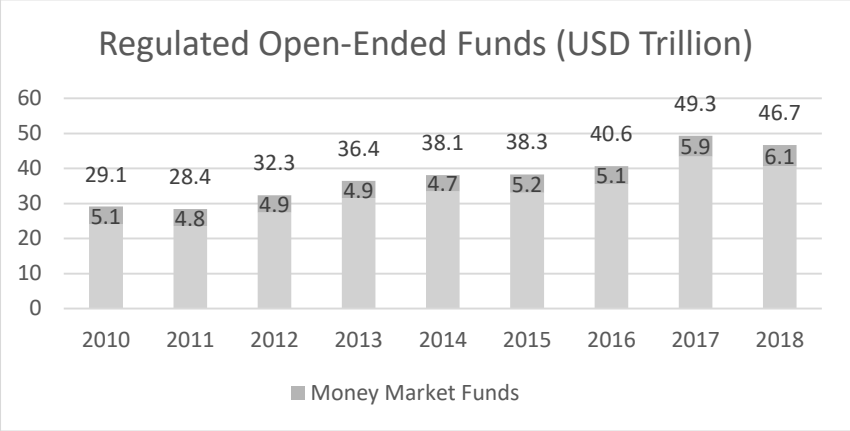

Figure 1: Worldwide Size of MMFs (Source: Investment Company Fact book 2019)

The main trigger behind the rise of MMFs in countries such as the US in the 1970s, and France a decade later, was the limitations on bank interest rates paid on savings accounts. However, after removing these limitations the MMF industry has continued to prosper. MMFs worldwide make investments in treasury securities, agency securities, commercial paper, certificates of deposit, repurchase agreements, and municipal notes.

One unique feature of US MMFs is that they are designed to keep the net asset value (NAV) per certificate constant, and are usually used interchangeably with bank deposits by investors

(Baklanova & Tanega 2013). In the US, MMFs, as well as mutual funds, are regulated by the Investment Company Act of 1940 and its various iterations. However, MMFs are closely governed by Rule 2a-7, which allows MMFs to assess the value of investor certificates at the amortized or the book value of their underlying investments, rather than at the market value; "that is, shares are valued at purchase price of securities minus computed premium or discount, amortized over the securities' remaining life" (Schmidt et al. 2016). Securities underlying MMFs are always high quality, highly liquid, short-term investments. Rule 2a-7 sets upper and lower limits on the shadow NAV and requires any MMF that exceeds a change of 0.5% in its calculated shadow NAV to break the fixed NAV[1] and switch to a floating NAV[2], in order to treat all fund investors equally. Fund managers estimate the shadow NAV by calculating the market values of the funds' underlying assets and subtracting total liabilities. The calculated NAV is then compared to the fixed NAV.

In the US, MMF certificates are maintained against a constant $1 NAV. Only three MMFs have been forced to break the $1 NAV historically; the most recent incident was in 2008, and arose as a result of the failure of Lehman Brothers, which was among the assets in which MMFs held investments. However, the Securities and Exchange Commission (SEC) then set tighter regulations to govern MMFs and ensure the high quality, liquidity, and diversification of their investments in order to avoid such incidents in the future. In July 2014, for example, the SEC amended MMF rules to include a requirement for a floating NAV for institutional prime MMFs, in addition to imposing redemption fees, in order to limit run risk in times of economic pressure (Cipriani and La Spada (2017).

In the Egyptian context, funds are an important investment vehicle. As of December 2016, there were 100 funds operating under the supervision of the Egyptian Financial Regulatory Authority (FRA), formerly called the Egyptian Financial Supervisory Authority (EFSA), with $2.1 billion of assets under management. A total of 26 MMFs currently exist, and are managed by banks and insurance companies as per the law. MMFs in Egypt mainly invest in time deposits (TDs) and treasury bills (T-bills), and are regulated by the FRA and the Central Bank of Egypt (CBE);

[1] A MMF certificate valued at a fixed NAV can be bought or redeemed anytime over its life at a constant value and is not affected by any fluctuations in the value of its underlying assets. In the US context, the fixed NAV of a MMF certificate is $1.

[2] A MMF certificate valued at a floating NAV derives its value from the value of its underlying assets and is bought and redeemed at its market value.

however, there is no rule similar to Rule 2a-7. Egyptian MMF certificates face a similar accounting treatment to the fixed NAV accounting method used in the US. Yet, unlike in the US, certificate returns are not distributed regularly, but are rather accumulated[3] on the NAV and realized by investors at exit. The market value of a MMF certificate is derived from the value of its underlying assets. Because MMF investments are focused on fixed-income securities, their fair value changes as interest rates are adjusted according to the monetary policy set by the CBE. Interest rates in Egypt fluctuated rapidly, during a very short period of time, when the Monetary Policy Committee increased interest rates by 9% from May 2016 to June 2017.

Despite the growth and relative importance of MMFs, the number of related academic studies over the past four decades can be considered sparse relative to studies on other types of funds. Most studies have focused on MMFs in the US and Europe, with no attention to the Egyptian MMF industry. On the grounds that T-bills make up the biggest chunk of MMF investments in Egypt, we demonstrate that fluctuations in T-bill yields lead to changes in MMF certificate value. Hence, the main contribution of this thesis is to prove that accumulated fixed NAV calculation is not fair in the Egyptian context, where interest rates are exceptionally volatile and subscriptions and redemptions are asymmetric. We aim at testing how these factors affect the fair value of MMF securities in Egypt and ultimately hold-to-maturity investors of funds with different durations. The findings of this thesis invite policy discussion around the regulatory framework and accounting treatment of MMFs in Egypt. To the best of our knowledge, this is the first paper that isolates this issue and reports it.

To carry out the study, weekly yields on the different types of T-bills (91, 182, 173 and 364 days) were obtained for the period 2014 to 2017, in addition to information on the number of outstanding MMF certificates. Results show that the certificate value of hold-to-maturity investors is negatively affected in the face of (1) increasing T-bill yields, (2) certificate redemptions exceeding subscriptions, and (3) higher fund durations.

The remainder of this thesis is organized as follows. Section two illustrates the prior research conducted on MMFs, while section three lays out the thesis hypothesis. Section four demonstrates

[3] In the Egyptian context, the term "accumulated fixed NAV" will be used in this research. It is equivalent to the US fixed NAV, in addition to accumulated returns (retained dividends) realized on the underlying assets.

the methodology of the research, and describes the data. Section five outlines the results, and finally section six details the thesis conclusion and limitations.

2. Literature Review

Academic interest in MMF accounting mainly emerged following the 2008 financial crisis and the collapse of the Reserve Primary Fund, which was a result of Lehman Brothers' default. The majority of the literature has focused on exploring all MMF-related reforms intended to circumvent losses incurred from investor runs on funds to redeem certificates valued, due to the practice of fixed NAV accounting, higher than the actual market value of the underlying assets. This thesis examines the effect of implementing changes in NAV calculations in Egyptian MMFs following the economic crisis, which resulted in an inflationary-driven monetary policy with double-digit interest. Although the direct focus of the thesis does not extend past the financial crisis, we shall nevertheless outline most of the related literature to provide an overview of past research in this area in general. This survey of the literature is organized as follows; in section one, we provide an overview on MMFs and how they evolved in the past. Section two discusses how MMFs reacted to the financial crisis in 2008. Section three considers the reforms that took place after the crisis, including those to accounting standards, while section four evaluates these reforms, with a focus on the implementation of a floating NAV.

2.1. Overview on MMFs

Peirce and Greene (2014) defined MMFs as follows: "A MMF is a mutual fund – a collectively owned pool of assets – that typically invests in low-risk securities, such as high-grade commercial paper, government securities, and certificates of deposit" (p. 3). As emphasized by Fisch (2014) and Hanson et al. (2015), MMFs are used by investors interchangeably with bank deposits, and serve as a considerably important cash-management tool for individuals and corporations. This is due to the ease of buying and selling certificates, in addition to the fixed certificate price offered. Fisch (2014) emphasized that the main feature of MMF certificates is that they can be bought and sold at a fixed price, while the price of other mutual fund certificates fluctuates regularly. He also pointed out that MMFs usually offer investors greater returns and higher diversification compared to bank deposits, in addition to facilities such as checks and debit card access.

Most of the academic literature to date has discussed the regulation of MMFs in the context of the US. US MMFs are regulated by the SEC under the Investment Company Act of 1940; however,

unlike banks, MMFs are not protected by federal insurance. In addition, Parkinson et al. (2013) stated that "only funds that register with the SEC and adhere to the portfolio restrictions of rule 2a-7 are allowed to market themselves to the public" (p. 718).

Schmidt et al. (2016) elaborated further on the implications of MMFs being regulated under Rule 2a-7 of the Investment Company Act. While mutual fund certificates are valued at their market value, MMF certificates under Rule 2a-7 can be valued at the amortized cost or book value of their underlying assets. Like banks, MMFs seek to remain liquid so as to meet any sudden redemptions, while holding less liquid assets to maintain high profitability. While banks may hold highly illiquid assets and lower-rated securities, MMFs, under governance by Rule 2a-7, may only hold very liquid assets with very high credit ratings.

MMFs originally came into existence as a response to the imposition of interest rate limits on bank deposit savings by the Federal Reserve in 1933. This rule was imposed in order to limit competition between banks, and resulted in banks taking on more risk and eventually failing. MMFs increased in popularity in the 1970s, when interest rates on bank deposits hit the limit that had been previously set by the Federal Reserve. Investors found MMFs to be a safe option that offers both liquidity and stability, in addition to competitive returns (Peirce & Greene 2014). Rozen and Katz (1983) highlighted a growth in US MMF assets from $2.2 billion in 1974 to over $200 billion in 1982, while Kacperczyk and Schnabl (2013) pointed out that while the limit on interest rates for bank deposits was eliminated, the size of the MMF industry continued to grow, hitting $2 trillion by the beginning of 2006. As per a study conducted by Hanson et al. (2015), investments in MMFs reached $2.68 trillion as of February 2014; however, this was lower than the peak of $3.5 trillion that MMFs reached before the crisis in September 2008 (Parkinson et al. 2013).

According to Parkinson et al. (2013) and McTigue & Pavlick (2014), MMFs can be categorized into prime funds, taxable government funds, and tax-exempt funds. Prime funds invest in short-term debt securities issued by financial and nonfinancial institutions, and were valued at $2.1 trillion as of September 2008. Government funds hold at least 99.5% of their assets in cash and US Treasury securities, and managed $0.9 trillion worth of assets as of the same date. Finally, tax-exempt funds invest in tax-exempt securities issued by state and local governments, and captured $0.5 trillion worth of assets as of September 2008. McTigue & Pavlick (2014) further distinguished

between retail and institutional funds, stating that retail fund ownership is limited to natural persons; i.e. individuals.

Witmer (2017) stressed the importance of studying MMFs since, as of December 2015, MMFs made up 18% of US mutual funds. In addition, since MMFs are usually a source of liquidity to their holders, managing their liquidity is important. Nevertheless, since they maintain a fixed certificate price, large redemptions are likely, and therefore liquidity management is important.

2.2. Rule 2a-7 and the Performance of Money Market Funds

As mentioned earlier, all US mutual funds, including MMFs, are governed by the SEC. The governance of MMFs by Rule 2a-7 entitles them to some privileges, but also a number of restrictions regarding their holdings. Several authors, including Pozen et al. (2011) and Cipriani and La Spada (2017) have discussed the nature of Rule 2a-7, including the fact that it encompasses restrictions regarding the securities' specifications in terms of maturity, credit quality, diversification, and liquidity. It is important to note that all mutual funds except MMFs report the market value of their certificates, which is derived from the market values of their underlying securities. On the other hand, if MMFs pass certain tests regarding their maturity and credit quality, they are allowed to report the $1 fixed NAV as their fair value. This is mainly due to the short maturity and high quality of their holdings, which makes a significant deviation between the floating NAV and the fixed NAV rare. Nevertheless, Rule 2a-7 requires US MMFs to calculate their floating NAV and report it in case it deviates by 0.5% from the fixed NAV. Pozen et al. (2011) highlighted that one of the main reasons why the value of MMF certificates may fluctuate on a daily basis, but eventually approach the book value, is that MMF securities are rarely traded, and are usually held to maturity. By their nature, at maturity fixed-income securities are redeemed at their par value, which is equal to the book value of the security at the maturity date. Pozen et al. (2011) elaborated further on the restrictions that Rule 2a-7 sets on MMFs by stating that "the rule requires MMFs' investment portfolios to have a weighted average maturity of 60 days. An MMF is required to invest at least 97% of its assets in first tier securities. At least 10% of a MMF's assets must be in cash, US Treasury securities or securities that mature within a week" (p. 171). Fund managers usually stick to even lower maturities and more liquid securities in order to meet

redemptions in case these redemptions occur collectively, as selling liquid assets incorporates lower transaction costs compared to selling illiquid assets.

2.3. Lehman Brothers' Failure, and MMFs during the Global Financial Crisis

MMFs were traditionally labeled safe investments, and used interchangeably with bank accounts due to their nature of holding short-term, high-quality securities and providing cash on demand for investors. However, this changed with the global financial crisis of 2008, when investors started to realize the risk associated with MMFs (Parkinson et al. 2013). Until the crisis, MMFs did not attract much attention from researchers and policy makers due to their safe nature. However, when Lehman Brothers declared bankruptcy one MMF – namely the Reserve Primary Fund – broke the buck; i.e. its shadow NAV fell below $0.995 (Peirce & Greene 2014). The Reserve Primary Fund did not have any holdings in Lehman Brothers up until August 2007. In November 2007, it started investing in Lehman Brothers' commercial paper. By May 2008, investments in Lehman Brothers were valued at $775 million, which made up 1% of the Reserve Primary Fund's holdings – much lower than the single-issuer limit of 5% set by the SEC (Kacperczyk & Schnabl 2013; Gordon & Gandia 2014). Even though investments in Lehman Brothers were not unusually high, its bankruptcy led to a huge run on MMFs by risk-fleeing investors, who were seeking liquidity and safety by transferring their investments to T-bills and bank deposits (Bengtsson 2013). As a result of these events, investments in institutional prime funds dropped to almost $900 billion, down from $1.3 trillion, in the few days following the crisis (Parkinson et al. 2013).

According to Brunnermeier (2013), "in what can be described as a 'first mover advantage', investors who sold early faced the prospects of being repaid their full amount, draining the fund of liquidity and high quality assets while leaving troubled instruments to their fellow MMF investors." This point is critical to the present research, because it highlights the fact that a fixed NAV does not treat all investors fairly, but rather differentiates between early redeemers and investors who remain in the fund following a crisis or a run. The Reserve Primary Fund certificates' value dropped by 3% from the $1 fixed NAV, reaching $0.97; this was much higher than the Fund's holdings in Lehman Brothers, which accounted for 1% of the fund investments. The US government decided to rescue the MMF industry by declaring a Temporary Guarantee Program that would insure investors' deposits in MMFs. It also offered support to issuers of

commercial papers by establishing a Commercial Paper Funding Facility, because all fund managers converted to treasury securities and stopped investing in commercial paper due to their lower risk tolerance following the crisis (Qiana & Tanyeri 2017). According to Kacperczyk and Schnabl (2013), the guarantee program was successful in preventing the run on MMFs; however, the risk faced by the MMF industry was completely shifted to the government.

2.4. MMF Reforms Following the Global Financial Crisis

As previously discussed, the MMF industry did not attract the attention of researchers and policy makers in its early years because it faced almost no trouble since its inception in the 1970s. However, after an important fund "broke the buck" during the global financial crisis of 2008, policy makers started proposing different reforms to eliminate, or at least mitigate, the risk associated with investments in MMFs. The most important reforms took place in 2010 and 2014, though some were implemented following the crisis in 2008. Such reforms have been discussed by a number of researchers, including Fisch (2014), Peirce and Greene (2014), Gordon and Gandia (2014), Cipriani and La Spada (2017), and Parlatore (2015). As noted above, after the Reserve Primary Fund "broke the buck" and all institutional MMFs were facing runs by risk-fleeing investors, the government decided to create a Temporary Guarantee Program to insure investors' money in MMFs (Fisch 2014). MMFs had to pay a fee for the government to guarantee the amortized value of their holdings as of September 19, 2008 (excluding new investments in MMFs). The government intervention significantly limited the run. The few years that followed the crisis were full of serious discussions on how to limit the volatility of MMFs and minimize the variance between the fixed NAV and the floating NAV. Peirce and Greene (2014) discussed in detail the MMF reforms that took place in 2010, including the imposition of restrictions on the investments' liquidity, credit quality, and maturity. Certain regulations were also imposed regarding the disclosure of information by MMFs. The first set of reforms targeted the funds' liquidity, wherein illiquid assets were limited to 5% of a fund's holdings, down from 10%, while daily and weekly liquid assets were increased to 10% and 30%, respectively. The SEC required MMFs to pass certain tests regarding their ability to maintain a stable NAV during hypothetical adverse events, including "changes in short term interest rates, an increase in shareholders' redemptions, a downgrade or a default on portfolio securities" (Peirce & Greene 2014, p. 1121). The second set

of rules concerned the credit quality of MMF investments. Investments in second-tier securities were limited to 3%, instead of the previous 5%, with a limit of just 0.5% for each individual issuer. The third set of rules was directed towards amendments regarding the maturity of securities held by MMFs. The highlight was limiting the weighted average portfolio maturity to 60 days, down from 90 days prior to 2010. The 2010 reforms highlighted the importance of having strict disclosure requirements when it comes to MMF holdings. Funds were required to publicly report their detailed holdings five days after the end of each month, and to leave them publicly accessible for at least six months. Before 2010, MMFs used to report their shadow NAV twice per year directly to the SEC. However, 2010 proposals required MMFs to post their market-based shadow NAV on their website on a monthly basis (Peirce & Greene 2014). According to Fisch (2014), the decisions were taken in "January 2010 by amending rule 2a-7 in an effort to make MMFs more resistant to the effects of adverse economic events in the future (p. 16)."

Four years following the above reforms, the SEC decided to tighten regulations on MMFs further. The key reform that took place in 2014 was forcing institutional MMFs to follow a floating NAV while maintaining the fixed NAV for retail and government funds. However, the latter two were required to announce their shadow NAV, their detailed holdings, and the fund subscriptions and redemptions on a daily basis. According to the reforms that were announced in July 2014, to become effective in October 2016, institutional MMFs were granted the option to suspend redemptions for up to 10 days, or impose a 2% liquidity fee, if its holdings in weekly liquid assets dropped below 30%. Reforms in 2014 incorporated further disclosure requirements for MMFs, including to "disclose current and historical market based NAV calculated on a daily basis and rounded to four decimal points" in addition to "any past use of fees and gates and historical sponsor support. Funds must disclose current and historical information about the percentage of daily and weekly liquid assets in their portfolio as well as current and historical information about net shareholder inflows and outflows" (Fisch 2014, p. 31).

2.5. An Evaluation of Reform Proposals

Though the reforms detailed above have been effective since the global financial crisis of 2008, further reforms are constantly being proposed by researchers and policy makers to avoid turbulence in the MMF industry in case of any future adverse events. The main proposals being

discussed by policy makers are shifting to a floating NAV, maintaining capital buffers, imposing liquidity fees and gates, and resorting to sponsor support.

The proposal of shifting to a floating NAV has been subject to particularly fierce debate. According to Peirce and Greene, among the important advantages of shifting to a floating NAV is that it eliminates investors' motive to redeem early on during adverse events, which causes a run on MMFs. A floating NAV would eliminate the first-mover advantage, and eliminate the perception that MMFs are as safe as bank deposits. Critics of this proposal, on the other hand, believe that it would not eliminate a run as it would not mitigate the real trigger behind a run – the risk, liquidity, and solvency of the underlying asset. Shifting to a floating NAV would require funds to incur high costs associated with tax, accounting, and recordkeeping. It would also take away the advantage of using MMFs as a cash-management tool for institutions by "ending the $1-in-$1-out characteristic" of MMFs (Peirce & Greene 2014, p. 1154). To confirm that shifting to a floating NAV would demotivate investors, Piece and Greene (2014) confirmed that after the reforms of 2014 investors shifted to government funds, which were allowed to continue using the fixed NAV, and redeemed their certificates in institutional funds, which were forced to shift to the floating NAV. Government funds went up from 33% in January 2015 to 74% in September 2017. The majority of this increase happened between June and October 2016 – that is, six months before the SEC regulation came into effect.

According to Beresford (2012), data from 2000 to 2010 proves that the deviation between the fixed and floating NAV is minor, and therefore there is no need to switch to a floating NAV. The author also stated that, on average, funds' shadow prices ranged $1.0020 in 2001–2002 to a low of $0.9990 during the global financial crisis, when interest rates were decreased significantly by the Federal Reserve, while the shadow prices for prime MMFs ranged from $1.0020 to $0.9980 during the same period. Pozen et al. (2011) indicated that MMFs should be allowed to use the fixed NAV due to the immaterial volatility of the market value of MMF securities, given their high quality and short-term maturity.

While having sufficient capital buffers would make MMFs relatively safe for risk-averse investors, and minimize the chance that a fund would be forced to break the buck, it takes a long time to build up this capital, especially in environments with low yield, such as the MMF industry. In

addition, having a small capital buffer that is insufficient to cover a fund's losses during a crisis sends false signals to investors that MMFs are safe (Peirce & Greene 2014).

The proposal of imposing liquidity fees has been debated among a number of researchers. This option offers several advantages, including limiting runs during a crisis by requiring redeeming investors to pay for liquidity, protecting remaining investors and preserving the NAV, and protecting the day-to-day liquidity that MMFs provide during normal times. On the other hand, as Peirce and Greene (2014) pointed out, implementation of liquidity fees "requires regulator formulation of trigger, which, if improperly structured, could accelerate runs" (p. 1155). Liquidity fees would also accelerate redemptions in anticipation of future trouble, to avoid paying fees in case of a run.

Finally, despite being a popular investment and cash management tool for individuals and businesses in Egypt, we are aware of no prior studies that cover the Egyptian Money Market.

3. Hypothesis Development

The effect of accumulated fixed NAV accounting on remaining shareholders in times of rising interest rates and when redemptions exceed subscriptions in MMFs.

In times of increasing interest rates and controls on subscriptions in MMFs, redemptions at the accumulated fixed NAV result in losses that are borne by the remaining shareholders in the funds on behalf of the redeemers who receive a higher value than deserved. According to ICI Research Report (2011), in the US an increase in interest rates by more than 3% in one day would lead to a reduction in the shadow NAV by 0.5%, holding all other conditions constant. We test this hypothesis in the Egyptian context, which is an ideal context for such testing since interest rates increased by 6% within a very short period of time.

In addition to the effect of increasing interest rates, ICI Research Report (2011) concluded that for a fund's NAV to deviate from the fixed NAV by 0.5%, redemptions have to reach 80% of the fund's certificates, holding all other conditions constant. Again, the Egyptian context is ideal to test this hypothesis due to the regulation that suspended subscriptions and allowed investors to redeem only, following the flotation of the Egyptian pound in November 2016.

We further test the conventional fact that as duration increases, the negative spread for remaining shareholders increases as well. This means that a fund that holds assets with longer maturities while interest rates are rising continues to face a decline in value until those assets mature and new ones are bought at the new interest rates. In light of the above, we hypothesize the following;

H1: Accumulated fixed NAV accounting treatment results in a higher negative spread for remaining shareholders in situations of rising interest rates and when redemptions exceed subscriptions.

4. Data & Methodology

4.1. Sample and Data Description

MMFs in Egypt are regulated by the Financial Regulatory Authority under Capital Markets Law no. 95/1992 (HSBC 2016).

According to the latest report issued by the Oxford Business Group (2017), as of November 2016, 35 fund managers were licensed by the FRA to manage funds, yet only 22 were active. It is also worth mentioning that 100 mutual funds existed as of the same date, with total assets of around EGP 40 billion. Out of the 100 mutual funds, 27 were MMFs, accounting for 82% of the total assets of Egyptian mutual funds.

During 2014, the CBE set barriers on investors entering the MMF industry by applying caps on the size of each MMF in existence. Due to these caps, funds did not accept new subscriptions and only redemptions were recognized. This resulted in net outflows of around EGP 8 billion from MMFs.

Since Egypt does not have the equivalent of US Rule 2a-7, which forces US MMFs to value their certificates at market price using the floating NAV when their value deviates by 0.5% up or down from their fixed NAV, this thesis examines the effect of using an accumulated fixed NAV method of accounting for MMF certificates on different investors. Our testing period, which runs from 2014 to 2017, is characterized by an economic crisis that resulted in currency shortages that warranted action by the CBE, including capital and currency controls accompanied by several interest rate hikes, as illustrated in treasury yields over the period presented in *Figure 2*.

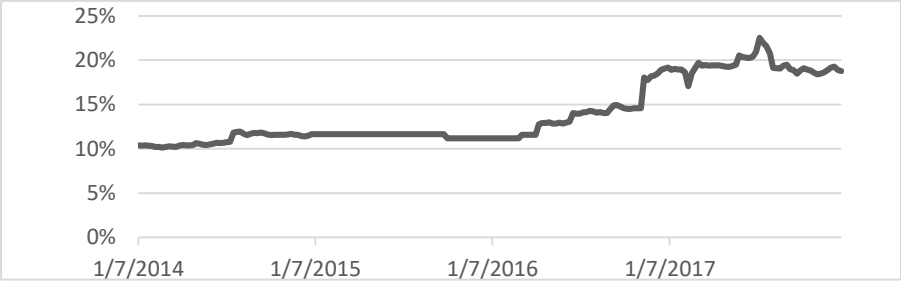

Figure 2: Egypt's Yield Curve, 2014–2017

Table 1: Yield Descriptive Statistics

Yield Descriptive Statistics (2014-2017)	
Mean	14%
Standard Error	0%
Median	12%
Mode	12%
Standard Deviation	4%
Sample Variance	0%
Kurtosis	(1.00)
Skewness	0.80
Range	12%
Minimum	10%
Maximum	23%
Count	208

We focus in this thesis on the period after the economic instability that Egypt faced, which eventually led to a number of interest rate hikes. *Table 1* shows the yield distribution during the period from 2014 to end of 2017. The volatility in interest rates is well proven by the results, given the wide range of 12%. A relatively high standard deviation of 4% makes it clear that interest rates have not been stable during that period with a mean of 14% and a minimum and maximum of 10% and 23% respectively.

In addition, subscriptions to MMFs were banned and only redemptions were fulfilled. Since the main component of MMFs in Egypt is T-bills, the data collection phase started off with retrieving data on T-bills with different maturities in Egypt. T-bills are issued weekly, with maturities of 91, 182, 173, and 364 days. The weekly data, retrieved using the "Refinitiv Eikon" database, included the T-bill type, auction date (issuance date), maturity date, and weekly yield. In addition, the weekly number of outstanding MMF certificates was obtained during the same time period in order to determine the number of weekly redemptions.

4.2. Methodology

The objective of our methodology was to examine how volatility in interest rates and asymmetric (redemption-only) structure of MMFs affect investors who redeem after interest rate hikes, versus those who remain in the fund. The methodology will analyze the effect of yield changes on MMFs that have different durations. To do this, we simulated four different types of Money Market Portfolios ($MMPs$), with each one modelling a MMF with a different duration, each of which invests exclusively in one type of T-bills (91, 182, 273, or 364 days). Our hypothesis is that when interest rates rise, and subscriptions are not allowed, sfunds that include T-bills with higher maturities are the most affected. MMFs in general target a lower duration to offset the effect of yield changes on the market value of the underlying assets. For example, in Egypt, the HSBC MMF, which invests in all four types of Egyptian T-bills, has a target duration of less than 60 days.

To explore the effect of yield changes on the different MMPs, we set target durations for the four MMPs as shown in Table 2.Table 2: Target Portfolio Durations $D_{i,t}^{P}$ for each MMP_i

MMP	T-Bill Type	Portfolio Duration ($D_{i,t}^{P}$)
1	91	45
2	182	91
3	273	136
4	364	182

Each of the portfolio's target duration ($D_{i,t}^{P}$), where i denotes each of our four MMPs (i = 1 to 4), is achieved through a mix of one of our treasury bills' type as well as weekly time deposits (*TDs*) – the other main component of MMFs in Egypt . $D_{i,t}^{P}$ is therefore a weighted average duration of both; T-bills and TDs, which is set at the targets outlined in Table 2 for each MMP_i and was calculated as follows:

$$D_{i,t}^{P} = \left(W_{i,t}^{TD}\ x\ D^{TD}\right) + \left(W_{i,t}^{TB} x\ D_{i,t}^{TB}\right) \quad \text{(EQ1)}$$

where D^{TD} is the *TDs*' duration, which is fixed at 7 days. $D_{i,t}^{TB}$ is the T-bills' duration, $W_{i,t}^{TD}$ and $W_{i,t}^{TB}$ are the weights of *TDs* and T-bills in each MMP_i, respectively.

$W_{i,t}^{TD}$ and $W_{i,t}^{TB}$ in each MMP_i were calculated with the objective of keeping the above target durations constant throughout the testing period. We assumed that each week one old T-bill matured and a new one was bought. Equations (2) to (4) outline those relationships.

$$W_{i,t}^{TD} = \frac{(D_{i,t}^{P} - D_{i,t}^{TB})}{(D^{TD} - D_{i,t}^{TB})} \quad \text{(EQ2)}$$

$$W_{i,t}^{TB} = 1 - W_{i,t}^{TD} \quad \text{(EQ3)}$$

$$D_{i,t}^{TB} = Average\ duration\ of\ all\ outstanding\ Tbills \quad \text{(EQ4)}$$

The weight of *TDs* required for each MMP_i, depends on each portfolio's target duration. Because of the higher liquidity of TDs, if a lower duration is desired, $W_{i,t}^{TD}$ would go up and $W_{i,t}^{TB}$ would go down.

A distinction was made throughout this research between two yields, namely amortized yield ($Y_{i,t}^{A}$) and floating yield ($Y_{i,t}^{F}$).

- $Y_{i,t}^{A}$ is the weighted average yield of all corresponding outstanding T-bills at the time of their issuance.
- $Y_{i,t}^{F}$ is the weekly changing yield quoted when new T-bills were issued.

When investors decide to redeem their certificates, T-bills have to be sold accordingly to satisfy the redemptions. T-bills are discounted at $Y_{i,t}^{F}$ to get their fair market value. In times of increasing interest rates, $Y_{i,t}^{F}$ results in a lower present value compared to the book value of the T-bill, which is calculated using $Y_{i,t}^{A}$. To assess the effect of using $Y_{i,t}^{A}$ rather than $Y_{i,t}^{F}$, to reach the value at which a certificate is redeemed, on the remaining investors in each MMP_i, an accumulated fixed NAV ($NAV_{i,t}^{A}$) and an accumulated floating NAV (NAV_{it}^{F}) were calculated.

$NAV_{i,t}^{A}$ is calculated by compounding accumulated weekly returns to the initial value per certificate; EGP 100 as follows:

$$NAV_{i,t}^{A} = 100 \prod_{t=1}^{N}(1 + Y_{i,t}^{A}) \quad \text{(EQ5)}$$

where t= week 1 to week N in the sample and $Y_{i,t}^{A}$ is weekly yield from t=1 to N.

NAV_{it}^{F}, on the other hand, is calculated by adding $NAV_{i,t}^{A}$ to the difference between the present value of the T-bills discounted at $Y_{i,t}^{F}$ and $Y_{i,t}^{A}$ as follows:

$$NAV_{i,t}^{F} = NAV_{i,t}^{A} + \frac{F}{(1+Y_{i,t}^{F})^{D_{i,t}^{TB}}} - \frac{F}{(1+Y_{i,t}^{A})^{D_{i,t}^{TB}}} \quad \text{(EQ6)}$$

where F is the face value per certificate in MMP_i.

Since investors redeem their certificates at the fixed value in addition to accumulated returns rather than the market value, losses resulting from the sale of T-bills are borne by the remaining investors in the MMP_i. We measure these losses per certificate remaining in MMP_i through a spread, $S_{i,t}$;

$$S_{i,t} = \frac{\sum_{t=1}^{N} R_t^7 (NAV_{i,t}^{A} - NAV_{i,t}^{F})}{Q_t^7} \quad \text{(EQ7)}$$

where Q_t^7 is the number of outstanding certificates in MMP_i at time *t* and is reduced every week with weekly Redemptions (R_t^7).

Since the research focuses on a time period during which interest rates were increasing and new subscriptions in MMFs were not allowed, the number of outstanding T-bills in all funds in Egypt was obtained. It was assumed that an equal number of redemptions took place weekly over every year. *Figure 3* is an illustration of annual redemptions and subscriptions in MMFs in Egypt from 2014 to 2018[4].

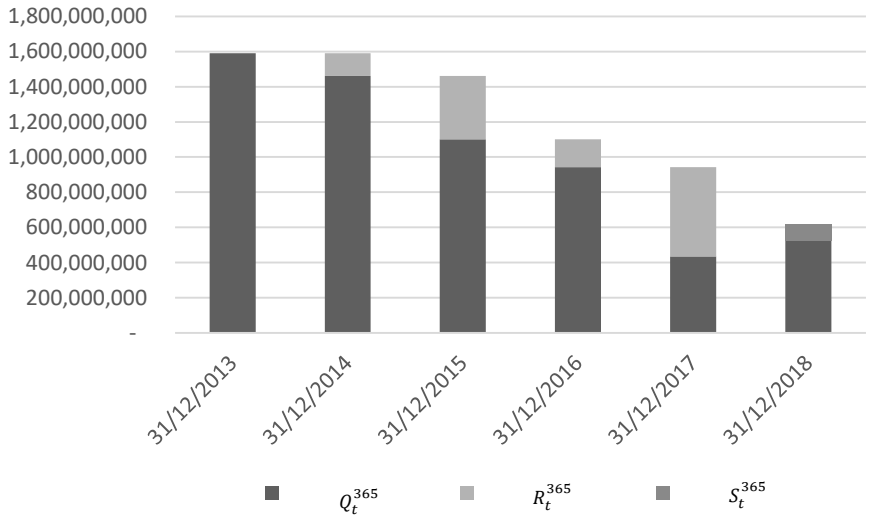

Figure 3: Egyptian MMFs' Annual Outstanding Certificates (Q_t^{365}), Subscriptions (S_t^{365}), and Redemptions (R_t^{365})

[4] Our testing period ends in 2017, as subscriptions started to re-appear in 2018.

5. Results

In this section we present the results of our tests which indicate that, in the presence of market disruptions and an asymmetric structure of MMFs, with an accumulated fixed NAV accounting treatment, investors who exit the MMF are better off, while those who remain bear the losses.

5.1. How much do Remaining Investors Lose from MMF Accounting?

In this section, we present the results obtained when studying the effect of increasing yields $Y_{i,t}^{F}$ and serial redemptions of MMP_i certificates on investors who remain in the portfolio; as measured by our spread variable $S_{i,t}$. The analysis is conducted on each portfolio separately to examine whether spreads are affected by fund durations.

Tables 3 through *6* in Panel I provide a snapshot of the simulated data across each portfolio to illustrate the effect that changes in yield have on MMPs with different target durations. Our main variable of interest is our spread $S_{i,t}$ which measured the accumulated losses of investors that remain in the fund. We also present a relative measure of the spread; $\%S_{i,t}$ defined as $\frac{S_{i,t}}{(NAV_{i,t}^{F} - S_{i,t})}$.

The results indicate that investors in portfolios with higher target durations are the ones that suffer most if they decide to remain in the fund after adverse events. We present the results of the simulation graphically in *Figure 5* which tracks the investor losses incurred from remaining in each portfolio

Panel I: Sample of Processed Data

Table 3: 91 days

Issue Date	$Y^F_{i,t}$ (%)	$NAV^F_{i,t}$ (EGP)	R^7_t	Q^7_t	$S_{i,t}$ (EGP)	%$S_{i,t}$ (%)
1/7/2014	10.392	100.00	-	1,590,416,916	-	-
1/14/2014	10.342	100.21	(2,494,702)	1,587,922,214	0.00	0.000
1/21/2014	10.377	100.40	(2,494,702)	1,585,427,512	0.00	0.000
12/12/2017	19.257	170.67	(9,753,765)	457,244,084	(0.05)	-0.032
12/19/2017	18.919	171.33	(9,753,765)	447,490,319	(0.06)	-0.032
12/26/2017	18.77	171.97	(9,753,765)	437,736,553	(0.06)	-0.033

Table 4: 182 days

Issue Date	$Y^F_{i,t}$ (%)	$NAV^F_{i,t}$ (EGP)	R^7_t	Q^7_t	$S_{i,t}$ (EGP)	%$S_{i,t}$
1/7/2014	10.874	100.00	-	1,590,416,916	-	-
1/14/2014	10.813	100.22	(2,494,702)	1,587,922,214	0.00	0.000
1/21/2014	10.625	100.48	(2,494,702)	1,585,427,512	0.00	0.000
12/12/2017	19.249	171.46	(9,753,765)	457,244,084	(0.25)	-0.147
12/19/2017	18.923	172.17	(9,753,765)	447,490,319	(0.25)	-0.148
12/26/2017	18.743	172.84	(9,753,765)	437,736,553	(0.26)	-0.148

Table 5: 273 days

Issue Date	$Y^F_{i,t}$ (%)	$NAV^F_{i,t}$ (EGP)	R^7_t	Q^7_t	$S_{i,t}$ (EGP)	%$S_{i,t}$
1/7/2014	10.964	100.00	-	1,590,416,916	-	-
1/14/2014	10.964	100.21	(2,494,702)	1,587,922,214	0.00	0.000
1/21/2014	10.829	100.48	(2,494,702)	1,585,427,512	0.00	0.000
12/12/2017	18.838	170.70	(9,753,765)	457,244,084	(0.58)	-0.342
12/19/2017	18.838	171.33	(9,753,765)	447,490,319	(0.59)	-0.346
12/26/2017	18.097	172.22	(9,753,765)	437,736,553	(0.60)	-0.347

Table 6: 364 days

Issue Date	$Y^F_{i,t}$ (%)	$NAV^F_{i,t}$ (EGP)	R^7_t	Q^7_t	$S_{i,t}$ (EGP)	%$S_{i,t}$
1/7/2014	11.126	100.00	-	1,590,416,916	-	-
1/14/2014	11.126	100.21	(2,494,702)	1,587,922,214	0.00	0.000
1/21/2014	10.808	100.61	(2,494,702)	1,585,427,512	0.00	0.000
12/12/2017	18.758	169.02	(9,753,765)	457,244,084	(1.17)	-0.695
12/19/2017	18.758	169.64	(9,753,765)	447,490,319	(1.19)	-0.704
12/26/2017	17.58	170.80	(9,753,765)	437,736,553	(1.20)	-0.705

Panel II: Effect of Increasing Yields on Remaining Investors

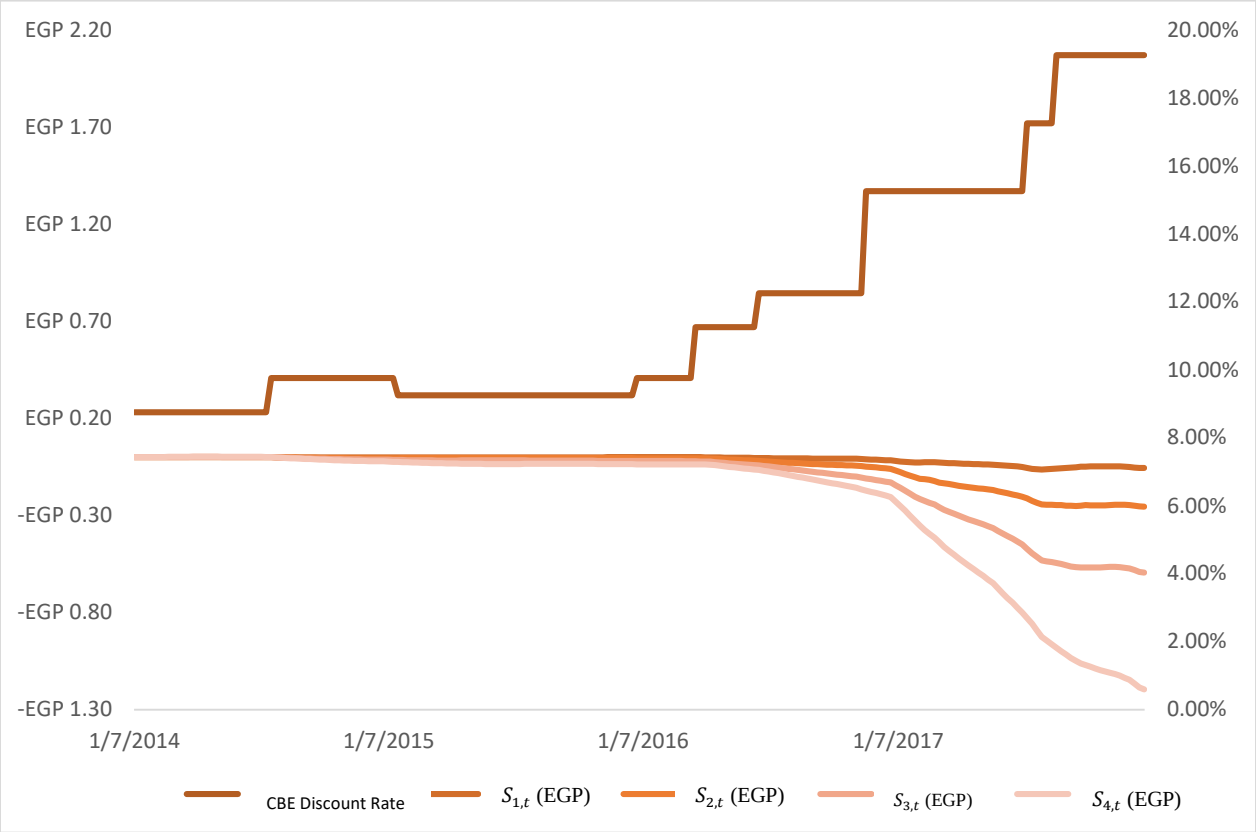

Figure 5: Effect of increasing yield on remaining shareholders in MMPs with different durations.

Table 7 summarizes the descriptive statistics for our results. They clearly show that there is strong relationship between yields ($Y_{i,t}^F$) and spread ($\%S_{i,t}$). The negative $\%S_{i,t}$ for the four MMPs indicates that having increasing yields ($Y_{i,t}^F$) and decreasing outstanding shares (Q_t^7) leads to losses for remaining shareholders in $each\ MMP_i$. Another interesting finding is that the higher the duration of the investments included in MMP_i, the higher the negative $\%S_{i,t}$. This can be explained by the fact that the yield ($Y_{i,t}^F$) is calculated as the average yield of all outstanding T-bills at time *t*. The shorter the duration of the T-bills, the faster the increasing yields ($Y_{i,t}^F$) is reflected into that average.

The thesis hypothesis is supported by the above results, since an increase in yields ($Y_{i,t}^F$) and increasing redemptions while no subscriptions are incorporated lead to a negative $S_{i,t}$, as shown in Panel I. In addition, the higher the duration of MMP_i, the higher the negative $S_{i,t}$. *Table 8* summarizes the negative $S_{i,t}$ and $\%S_{i,t}$ for MMP_i by the end of the testing period. Given the size of investments in MMFs an accumulated loss of -0.7% on our highest duration portfolio is of economic significance.

Table 7: $\%S_{i,t}$ Descriptive Statistics

	91 Days	**182 Days**	**273 Days**	**364 Days**
Mean (%)	-0.008	-0.036	-0.082	-0.148
Standard Error (%)	0.001	0.004	0.008	0.015
Median (%)	-0.002	-0.005	-0.016	-0.030
Mode (%)	N/A	N/A	0.000	0.000
Standard Deviation (%)	0.012	0.052	0.116	0.218
Sample Variance (%)	0.000	0.000	0.000	0.000
Kurtosis (%)	30.259	15.734	43.871	82.526
Skewness (%)	-134.432	-133.447	-141.796	-153.330
Range (%)	0.041	0.154	0.349	0.707
Minimum (%)	-0.041	-0.154	-0.348	-0.705
Maximum (%)	0.000	0.001	0.001	0.002
Sum (%)	-1.755	-7.546	-16.965	-30.764
Count	208	208	208	208

Table 8: Effect of Fund Duration on remaining Investors' Spread

T-bill Type	$D_{i,t}^{P}$	$S_{i,t}$	$\%S_{i,t}$
91	45	-0.06	-0.03
182	91	-0.26	-0.15
273	136	-0.60	-0.35
364	182	-1.20	-0.70

5.2. What Explains the Negative Spread?

The results shown in Section 4.1 support our hypothesis, showing that rising $Y_{i,t}^F$, increasing R_t^7, and higher durations all contribute to a higher negative effect for remaining shareholders.

In order to quantify the effect of changes in $Y_{i,t}^F$ and serial R_t^7 on $\%S_{i,t}$ for each MMP_i using our weekly data *t*, we estimate the following multivariate panel regression model using fixed effects to control for the different MMP durations *i;*

$$\%S_{i,t} = \alpha + \beta_1 Y_{i,t}^F + \beta_2 R_t^7 + \varepsilon_t$$

Table 9: Panel Regression Results

Regression Statistics	
Cross-Sections Included	4
Total Panel observations	832
R-Squared	0.409968
Adjusted R-Squared	0.408545
F-Statistic	288.0044
Probability (F-Statistic)	0.000000

Variable	β	T-Statistic	Probability
Intercept	0.005482	15.54054	0.0000
$Y_{i,t}^F$	-0.017773	-12.80148	0.0000
R_t^7	-0.182362	-7.131622	0.0000

Our econometric analysis supports our hypothesis, since changes in $Y_{i,t}^F$ and R_t^7 both appear to be very powerful in changing $\%S_{i,t}$. Both variables are negatively correlated with $\%S_{i,t}$. We find through the above results that every 1% increase in $Y_{i,t}^F$ is associated with a 0.0177% drop in $\%S_{i,t}$, while every 1% increase in redemptions[5] results in a 0.1824% drop in $\%S_{i,t}$.

[5] We rescaled the redemptions into % redemptions to be consistent with $\%S_{i,t}$ and $Y_{i,t}^F$

6. Conclusion and Limitations

6.1. Conclusion

In this thesis, we investigate the implication that early redemptions have for hold-to-maturity investors in a market with volatile interest rates – specifically Egypt. Similar studies that have been conducted worldwide, which have mainly focused on discussing the nature of MMFs and how they were affected during the global financial crisis, were used as a reference. However, while researchers have studied the post-crisis reforms and evaluated them, the focus of this thesis is on the effect that an accumulated fixed NAV has on certificate holders, and the fact that this effect suggests that implementing an accumulated floating NAV is a fair method of accounting for MMFs in Egypt during and post economic disruptions. We gathered data on all T-bills – which are the main component of MMFs in Egypt, besides TDs – as well as data on the number of aggregate outstanding MMF certificates of all funds in Egypt, and processed this data in several ways. An increase in interest rates would lead to a decline in the value of fixed-income securities. As T-bills are fixed-income securities, and one of the two main constituents of MMFs, an increase in interest rates would automatically lead to a decline in the MMF certificate value. Nevertheless, redeeming at the accumulated fixed NAV means that investors who redeem during times of increasing interest rates get a value that is higher than the fair market value of their certificate. Thus, hold-to-maturity certificate holders are negatively affected, as their certificate value is hit not only by the decline in fair value of the underlying assets, but also by the spread between the accumulated fixed NAV and the accumulated floating NAV. The research findings also suggest that the higher the duration of a fund, derived from the duration of its underlying investments, the higher the adverse effect on hold-to-maturity certificate holders.

The findings of this research should provide guidance to regulators of MMFs in Egypt in creating a rule similar to the SEC's Rule 2a-7, which regulates and monitors MMFs in the US. The most important requirement of Rule 2a-7 is that any MMF with a shadow NAV lower than $0.995 or higher than $1.005 must switch to a floating NAV in order for all fund investors to be treated fairly and bear any profits or losses of fluctuating market values of MMF securities equally.

The economic turbulence which caused market irregularities provided researchers and policy makers with a natural experiment to test the implications of increasing interest rates and asymmetric redemptions and subscriptions on different types of MMF investors. This is useful for policy makers in Egypt as to visualize the importance of introducing tighter regulations on MMFs and revisiting their accounting treatment; including introducing an accumulated floating NAV in times of economic distress.

6.2. Limitations

While collecting the data for this research and constructing the MMPs, we faced some challenges. While the duration for T-bills was identified depending on the T-bill type, the duration of TDs was assumed to be seven days to enable us to construct the different funds and manage the duration of the MMPs to be the weighted average duration of T-bills and TDs while enabling us to reshuffle the portfolio on a weekly basis.

Thus, among the limitations was the fact that every MMP contained only one type of T-bill, which in reality is not the case; however, this helped in illustrating the idea that it is hold-to-maturity certificate holders of funds with a higher duration who suffer most from early redemptions, as changes in interest rates take more time to be reflected in the amortized yield which is used to discount their T-bills to get their market value.

Furthermore, throughout the analysis, the interest rate earned on TDs was ignored when calculating the accumulated floating NAV, and only T-bills' yields were taken into consideration. That is an underestimation of both, the accumulated floating NAV and the accumulated fixed NAV, as returns on TDs should be realized by the certificate holders.

It would have been ideal to obtain the exact breakdown of MMFs in Egypt aggregately in order to construct a MMP that mimics already existing funds. Also, exact returns on the fund's underlying securities would have helped to calculate more accurate NAVs; accumulated fixed and floating. Future research should address the appropriate policy reforms suitable for the Egyptian MMF industry to guarantee a fair treatment of all MMF investors during times of market irregularities.

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Appendix 1

Data Description

Column Name	Abbreviation (if any)	Description	Formula (if any)
Type	-	T-bill type (91,182,273,364)	-
Issue Date	-	Issuance date of T-bills (weekly auction date)	-
Maturity Date	-	Maturity date of T-bills	-
Yield	$Y_{i,t}^{F}$	Yield at issuance date	-
Duration	-	Target duration of each MMP_i	-
TDs' Weight	$W_{i,t}^{TD}$	Weight of TDs in the fund, optimized using solver to keep weighted average duration of fund at the target duration of each MMP_i.	$W_{i,t}^{TD} = \frac{(D_{i,t}^{P} - D_{i,t}^{TB})}{(D^{TD} - D_{i,t}^{TB})}$
T-Bills' Weight	$W_{i,t}^{TB}$	Weight of T-bills in fund, optimized using solver to keep weighted duration of fund at the target duration of each MMP_i.	$W_{i,t}^{TB} = 1 - W_{i,t}^{TD}$
TDs' Duration	D^{TD}	Kept at 7 days, assuming that we can liquidate these amounts after 7 days from deposit to allow for reshuffling the fund constituents on a weekly basis.	-
T-bills' Duration	$D_{i,t}^{TB}$	Weekly average duration of all outstanding T-bills	-
Weighted Duration	$D_{i,t}^{P}$	Weighted average duration of TDs and T-bills	$D_{i,t}^{P} = (W_{i,t}^{TD} \; x \; D^{TD}) + (W_{i,t}^{TB} x \; D_{i,t}^{TB})$
Amortized Discount Rate	$Y_{i,t}^{A}$	Average yield of all outstanding T-bills	-
Floating Discount Rate (Yield to Maturity)	$Y_{i,t}^{F}$	Weekly floating yield	-
NAV (Amortized Yield)	$NAV_{i,t}^{A}$	Certificate net asset value using the amortized yield as the discount factor.	$NAV_{i,t}^{A} = 100 \prod_{t=1}^{N}(1 + Y_{i,t}^{A})$
NAV (Floating Yield)	$NAV_{i,t}^{F}$	Certificate net asset value using the floating yield as the discount factor.	$NAV_{i,t}^{F} = NAV_{i,t}^{A} + \frac{F}{(1+Y_{i,t}^{F})^{D_{i,t}^{TB}}} - \frac{F}{(1+Y_{i,t}^{A})^{D_{i,t}^{TB}}}$

Number of Redemptions	R_t^7	Number of redeemed fund certificates every week.	$R_t^7 = \frac{R_t^{365}}{52}$
Number of Outstanding Certificates	Q_t^7	Number of weekly outstanding fund certificates.	-
Spread	$S_{i,t}$	Losses borne by shareholders who remain of the fund, which result from early redemptions at the accumulated fixed NAV.	$S_{i,t} = \frac{\sum_{t=1}^{N} R_t^7 \, (NAV_{i,t}^A - NAV_{i,t}^F)}{Q_t^7}$
Spread %	$\%S_{i,t}$	Spread divided by the actual value per remaining certificate.	$\%S_{i,t} = \frac{S_{i,t}}{(NAV_{i,t}^F - S_{i,t})}$