Humanities and Social Sciences Letters
2025 Vol. 13, No. 3, pp. 1160-1174
ISSN(e): 2312-4318
ISSN(p): 2312-5659
DOI: 10.18488/73.v13i3.4392

Liquidity stress testing for investment funds: Insights from Vietnam

Hang Thi Ngo[1]
Anh Thi Xuan Tran[2]
Nhung Hong Dao[3+]

[1,2,3]*Faculty of Finance, Banking Academy of Vietnam, Hanoi, Vietnam.*
[1]*Email: ngohang@hvnh.edu.vn*
[2]*Email: anhttx@hvnh.edu.vn*
[3]*Email: nhungdh@hvnh.edu.vn*

(+ Corresponding author)

Article History
Received: 13 March 2025
Revised: 28 July 2025
Accepted: 21 August 2025
Published: 1 September 2025

Keywords
Expected shortfall
Investment funds
Liquidity stress test
Value at risk
Vietnam.

ABSTRACT

This research aims to assess the liquidity stress and resilience of investment funds in Vietnam by applying advanced risk modeling techniques, Specifically, value at risk (VaR) and expected shortfall (ES). The study systematically evaluates fund-specific liquidity vulnerabilities and the adequacy of liquidity buffers across different fund types using comprehensive monthly data from 2013 to 2021. The empirical findings reveal substantial variations in liquidity stress exposure with bonds funds and exchange-traded funds (ETFs) demonstrating significantly higher resilience against redemption shocks compared to traditional open-ended equity funds. These differences are mainly attributed to the inherent liquidity profiles of their underlying portfolios and the operational structures of each fund category. Additionally, the analysis identifies that some funds hold excessive liquidity reserves, indicating potential capital inefficiencies. While this conservative approach may mitigate short-term liquidity risks, it also results in suboptimal capital utilization, suggesting an essential trade-off between liquidity preparedness and return maximization. The research underscores the importance of integrating liquidity stress testing into regular fund management practices in Vietnam. The study provides practical implications for fund managers and regulators, especially within frontier and emerging markets where liquidity risk frameworks remain underdeveloped by adapting a tailored, robust liquidity stress testing model specifically adapted to Vietnam's investment fund.

Contribution/Originality: This study is the first to implement a liquidity stress testing framework tailored to Vietnam's investment funds, offering cross-category insights and revealing inefficiencies in capital allocation. It bridges global regulatory models with emerging-market realities, providing a scalable, policy-relevant tool for fund resilience assessment and replication in similar frontier markets.

1. INTRODUCTION

The development of the financial market and the asset management industry are always associated with the emergence and the growth of various investment funds. This is a common form of collective investment vehicle established from the joint investment of investors in which the investors increase their asset accumulation through investment funds and experts within an expected risk-return profile arranged between the investors and the fund managers. Apart from managing the risk side of the investment portfolios for investors, the fund experts also need to consider the operational risks of the fund itself which could arise from the redemption requests of the investors. This emphasizes the application of a liquidity risk management practice. The liquidity risk management of an investment fund reduces the risk of a liquidity mismatch between the liquidity of an investment asset and the fund liquidity to fulfil the investors' redemption requests on fund units. This liquidity gap could trigger other risks

including the fund's reputation erosion and risks of selling off the fund's portfolio at undesirable trading prices, deeply weakening the fund's performance further. This could prevent the fund from achieving the return-risk targets committed with the fund investors in the investment policy statement. This leads to a second-round hit on the fund's image and reputation as well as future fundraisings. For example, in November 2024, emerging market bond funds experienced significant outflows with $3.2 billion withdrawn in a single week—the largest in over two years (Reuters, 2024). Notably, hard currency funds saw $2.9 billion in withdrawals, and non-ETF outflows climbed $2.2 billions which led emerging market funds to come under high pressure. This trend was influenced by expectations of U.S. policy changes leading to a stronger dollar and higher interest rates, prompting investors to reallocate funds to developed markets (Reuters, 2024). Therefore, effective liquidity risk management not only ensures that the fund can respond proactively to redemption requests but also ensures the principle of fairness between investors entering and investors exiting the fund.

The stress testing model exclusively for investment funds was first introduced in 1999 through the Financial Sector Assessment Programs (FSAPs) conducted by the International Monetary Fund (IMF) in collaboration with the World Bank. Since stress testing has received much attention from researchers and practitioners, including central banks. Stress tests become an effective tool in assessing the stability and resilience of the financial system to adverse shocks in the economy. Since 2017, the IMF has issued a general guideline to conduct liquidity risk testing for investment funds and recommended countries develop their regulations and use stress tests in liquidity risk management of investment funds. This is not only meaningful for investment funds, the fund management industry but also for the financial system pursuing macro prudential targets.

There has been limited research on liquidity stress testing for investment funds despite the increasing importance of liquidity stress testing. Unlike banks and insurance firms, which are subject to mandatory stress testing regulations (e.g., Basel III, Solvency II), investment funds have faced less stringent liquidity stress testing requirements. Moreover, the research mainly focuses on advanced markets, such as U.S., Ireland, Sweden and Luxembourg (Bouveret, 2017) or Hong Kong and Singapore (McKenzie, 2020; Monetary Authority of Singapore (MAS), 2018). Liquidity stress testing may require detailed, high-frequency data on fund holdings, redemption flows, liquidity assets, and more importantly, the standardized liquidity weight of the asset group. Many funds, particularly in emerging markets do not publicly disclose such detailed data and sometimes no legal document regulates the calculation, limiting research opportunities.

In Vietnam, the development of the stock market over the past 20 years has evidenced the significant contribution of investment funds, the institutional investors in the market. Statistics show that by August 2024, the total number of active investment funds in Vietnam has increased to 110 funds, including 58 open-ended funds, 3 closed-end funds, 33 member funds, 15 ETFs and 1 real estate fund with a total net asset value under management (AUM) of over VND 74 trillion. Given the large-scale transactions and investment, any potential subsequent sell-offs of mutual funds could cause the share prices to fall dramatically and seriously affect the investment sentiment of other investors, fuelling a severe decrease in the market liquidity and prices. From a macro-prudential perspective, an assessment of the liquidity stress of an investment fund is essential to help ensure the sufficient liquidity status for the fund and enhance the fund managers' ability to diagnose potential vulnerabilities. These achievements further support the fund managers in investment decision-making, increase investors' trust in the asset management industry, and reduce potential reputational and systemic risks. This again emphasizes the importance of identifying and testing liquidity stress for the investment fund management system in Vietnam.

This study investigates and performs a liquidity stress test on existing investment funds in Vietnam and is one of the limited numbers of studies researching the liquidity risk of investment funds across the globe. Therefore, we highly believe that our research and findings certainly and noticeably bring additional value to how Vietnamese investment funds specifically behave under liquidity stress, how their risk metrics compare to global benchmarks, or how effective current practices are in an emerging-market context. The Vietnamese fund sector has unique features

– a smaller market size, different investor behavior, and less widespread use of advanced liquidity tools which may influence outcomes differently than in developed markets. The 2022 bond fund episode showed a severity of net asset value (NAV) impact that might exceed what similar funds in more developed markets experienced for comparable outflow percentages indicating the need for tailored analysis (Dragon Capital, 2022).

While prior studies on liquidity stress testing in developed markets often focus on fixed-income funds and assess liquidity risk based on geographic allocations, such as the frameworks proposed by the European Securities and Markets Authority (ESMA) (2019a) for developed markets. Our study takes a broader, more nuanced approach by classifying investment funds based on security types. This distinction allows for deeper insights into the structural liquidity resilience of different fund categories. Specifically, our empirical findings reveal that ETFs and bond funds tend to be more resilient to liquidity stress than equity funds, largely due to their stronger liquidity buffers. However, we also find that some funds hold excessive liquidity reserves which may indicate capital inefficiencies. While this may reduce short-term risk, it leads to suboptimal capital utilization, suggesting a trade-off between liquidity preparedness and return maximization. By introducing and applying a tailored, robust liquidity stress testing model specifically adapted to Vietnam's investment fund, fund managers can strike a better balance—maintaining sufficient liquidity to withstand shocks while ensuring capital is deployed more effectively for optimal returns. This insight is especially valuable for emerging markets like Vietnam where liquidity risk management frameworks remain underdeveloped, and enhancing fund-level resilience is crucial for market stability and growth.

Moreover, this study's empirical results are significantly important for the current practice of managing investment funds in Vietnam to support the sustainable development of investment funds and the roadmap of Vietnam's stock market upgrade. Our findings offer actionable insights that can inform fund-level decision-making, enhance investor protection, and support the broader objective of financial system stability. From a micro perspective, supervisors and other stakeholders can use liquidity stress test results to assess the resilience of a particular fund to liquidity shocks. From a macro-financial stability perspective, if individual funds fail to recover from a redemption shock, there will be massive selling pressure within a short timeframe causing securities sale-off, seriously affecting the liquidity of the whole industry and the market.

Finally, given the global shift toward macro prudential oversight in the asset management industry as highlighted by the Financial Stability Board (FSB) (2017) and International Monetary Fund (IMF) (2022a), there is a growing need for standardized tools that can assess fund-level vulnerabilities in diverse financial ecosystems. Our study could be a for regulation and supervision purposes regarding the healthy performance of investment funds with a detailed and comprehensive description of stress testing practice provided. The model presented in this research integrates practical insights drawn from international guidelines (e.g., (European Securities and Markets Authority (ESMA), 2019a, 2019b)) with empirical calibration based on actual fund behavior and market liquidity constraints observed in Vietnam. This enables its application beyond the domestic context, particularly in other emerging or frontier markets where liquidity risk management frameworks remain nascent or inconsistently enforced. Our methodology aligns with these regulatory imperatives by allowing supervisors to simulate extreme but plausible redemption scenarios, assess liquidity buffers, and diagnose potential contagion effects from fund-level stress to broader market dynamics. Therefore, it provides regulators, fund managers, and policymakers in similar capital market environments with a practical guide to identifying, quantifying, and mitigating liquidity mismatches. In a broader perspective, the application of such a liquidity stress testing framework is not only policy-relevant but critically important for strengthening systemic resilience, particularly in jurisdictions where secondary markets lack depth, market-making capacity is limited, and investor behavior tends to exhibit herding during periods of uncertainty or volatility. Accordingly, the study attempts to address the following research questions: (i) What level is the liquidity stress of investment funds in Vietnam? (ii) Does the liquidity stress vary across investment fund types? (iii) Can existing investment funds in Vietnam withstand liquidity stress?

The rest of the paper is structured into four main parts, including literature review, materials and methods, results and discussion, and conclusion and managerial implications.

2. LITERATURE REVIEW

Over the past decade, the asset management industry worldwide has experienced significant growth, and the asset value of investment funds is constantly increasing. However, the fluctuations in the financial market recently have also shown that the stability and safety of the financial system related to the risks of the investment have been constantly being amplified. Most funds meet daily liquidity requests of investors while their investment portfolios may focus on less liquid asset classes. Consequently, if the prices of investment assets fall sharply, investment funds, confronted with massive redemption requests from their investors, could become insolvent due to the sizable sales and a downward spiral in the asset prices, threatening the stability of the national financial market. Regarding this, liquidity stress testing (LST) regularly and a guiding framework for LST play a crucial role in improving the funds' risk assessment and management practice (International Monetary Fund (IMF), 2015). Furthermore, as LST is an important liquidity risk assessment tool in the overall risk management process for investment funds, this tool allows fund managers to check the liquidity stress of each investment fund, thereby assessing its impact on the entire industry as well as the financial market. A framework for testing liquidity stress of investment funds includes its specific definitions and measures, and methods of assessing recovery probability of investment funds after liquidity shocks (Bouveret, 2017). This study also emphasizes that the objective of the liquidity stress test is to assess the resilience of investment funds either at the individual fund level or at the sector-wide level after severe liquidity shocks. Similarly, in February 2019, the European Securities Commission for the first time officially issued guidelines on LST for investment funds. This regulation has designed liquidity stress scenarios, liquidity control measures and essential policies regulating investment funds' operation and liquidity matters. The regulation also recommends the frequency for each fund to reconduct the LST process (European Securities and Markets Authority (ESMA), 2019b). In Asia, Hong Kong and Singapore have proactively taken actions on managing liquidity risks of investment funds. Since the 2008 global financial crisis, managing the liquidity risk of public and private equity funds has been a major focus of the Hong Kong Securities and Futures Commission (SFC). SFC developed detailed guidance on liquidity risk management in 2016 to assist fund managers in ensuring effective liquidity risk management for investment funds (most of which are open-ended funds). The 2018 revised version requires fund managers to regularly conduct liquidity assessments in various scenarios, including stress scenarios and offers several liquidity risk management techniques and procedures for investment funds. The SFC also recommends that LST results should be implemented frequently to timely assess the liquidity risk exposure that emerged from severe adverse changes in the market conditions and then help the managers and regulators produce appropriate risk management strategies to refrain the fund's liquidity shocks from dampening the market negative conditions further into uncontrollable phases (McKenzie, 2020).

In Singapore, the Monetary Authority of Singapore (MAS) has introduced a liquidity risk management framework for collective investment schemes (CIS). This framework provides guidance on CIS liquidity risk management practices to protect investors from the liquidity risk of investment funds. According to Singapore law, fund management companies will be responsible for putting in place a risk management framework to identify, handle, and monitor risks related to the clients' assets under their management. In addition, MAS also issued Guidelines on Liquidity Risk Management Practices for Fund Management Companies on August 16, 2018, dedicated to the management of liquidity risk in CIS. The MAS also revised its code on collective investment schemes to address liquidity risk in money market funds by introducing additional portfolio requirements (Monetary Authority of Singapore (MAS), 2018). The framework for managing liquidity risks has been a significant focus of Singapore's authorities. Although the liquidity stress test of investment funds has been specified and mandatory in some countries and regions to strengthen the risk management of financial institutions and the

stability of the financial markets, in many economies, due to the characteristics as well as the size of the investment funds industry, the appropriate guiding framework as well as relevant regulations on the liquidity stress test have not yet been developed.

A clear identification of each type of liquidity risk is necessary to select and design an appropriate liquidity stress test. For an investment fund, liquidity risk consists of two main categories (AMIC & EFAMA, 2019): (i) Fund liquidity risk, which is the probability that a fund over a certain period is unable to fulfil its obligations, the ability to redeem fund units upon investors' requests and (ii) market liquidity risk, assessing the fund's ability to promptly liquidate their holdings.

In the process of testing the liquidity stress of an investment fund, the first step is to scrutinize the fund units' withdrawal shock. This redemption shock is then assessed with the fund's liquidity buffer which is based on the fund's asset classes. Next, the liquidation approach will be used to model how the fund manager responds to the redemption crisis - that is, the decision on the proportional sale of the most liquid assets to the most illiquid ones to maintain the structure of the portfolio under a specific investment policy statement. If the size of the liquidity buffer is not enough to cover the fund shares' buyback shocks and the fund also does not pass the liquidity stress testing process under the liquidation approach, the fund will confront several considerations: (i) an asset sell-off, especially when the fund's portfolio includes illiquid securities, this process will become costly and deteriorating the fund's performance; (ii) Temporarily close the redemption option (redemption gates) , the fund may decide to suspend the buyback of fund units for time or (iii) exploit credit support from banking institutions.

Finally, after measuring the repurchase shock and the investment fund's liquidity buffer, the fund's resilience to liquidity shocks is measured. A fund's estimated resilience value of greater than 1 implies that the fund has enough liquid assets to cope with a liquidity shock and vice versa.

Despite the importance of LST, empirical findings on a LST for different types of investment funds are relatively modest. Arora, Bédard-Pagé, Leblanc, and Shotlander (2019) performed LST for fixed-income mutual funds in Canada for the period from January 2002 to December 2018. The method used to test liquidity stress for investment funds is called Ceto. Ceto is composed of two modules including liquidity demand and liquidity supply. The modules work sequentially to quantify the impact of the liquidation of bond funds on the market liquidity. The results reveal investors' sensitive reactions to the fund performance and portfolio managers' liquidity management decisions. Since April 2016, money market funds have been required by the US Securities and Exchange Commission (SEC) to test their ability to maintain at least 10% weekly liquid assets and minimize fluctuations in the value of investment assets measured by changes in Net Asset Value (NAV) during hypothetical stressful situations (events), such as increases in short-term interest rates combined with varying increases in claims from investors. On this basis, Wells Fargo & Company (2015) have performed liquidity stress tests based on hypothetical scenarios: a 400-basis point increase in interest rates in one day combined with 20% reductions in investor's capital, to provide a warning level for a fund with a constant NAV raised interest rates by nearly 800 basis points in one day, along with 20% investors' redemption requests. These stress test results demonstrate that if investors withdraw 43% of their investment in the fund, the fund will reach the warning liquidity risk threshold with a probability up to 0.9975. If the investor withdraws up to 48% of the invested capital, the fund will lose its liquidity completely. The stress test also shows that the fund will require investors to not plan to withdraw about 16% of their investment in a day to avoid causing a weekly drop in liquid assets of less than 30% of the fund as per the regulations of the Securities and Exchange Commission.

In Vietnam, studies on the liquidity stress of investment funds operating on the stock market are almost nonexistent. There has not been a single and specific study on the stress test of investment funds. Previous studies have mainly looked at the performance of the fund or provided a qualitative assessment of the relationship between the investment fund's tradings and stock market volatility. This comes in part from the current practice of managing and supervising investment fund activities in Vietnam. Similar to Thailand, the State Securities

Commission of Vietnam has not yet issued any guidelines or regulations on liquidity stress testing for investment funds. There have been no specific requirements on fund liquidity management as well as liquidity reporting requirements and standards to help regulators to monitor and intervene promptly, ensuring the safety of the fund's operations to protect investors as well as ensure the stable development of Vietnam's stock market. Therefore, our research is the first study on liquidity stress testing for investment funds in Vietnam to provide the most comprehensive assessment of the resilience of investment funds in Vietnam before liquidity shocks, thereby serving as a premise for proposing appropriate solutions and recommendations.

3. MATERIALS AND METHODS

3.1. Materials

The coverage of this study focuses on open-ended funds (stocks and bonds) and exchange-traded funds (ETFs) because the operational nature of these funds is closely related to the potential emergence of redemption shocks, which could trigger liquidity stress for the fund and the entire market. This is in line with previous literature stating that in periods of market stress, this structural liquidity mismatch can amplify shocks: funds holding hard-to-sell assets but allowing quick redemptions face pressure to sell assets at fire-sale prices, which in turn depresses valuations and incentivizes further withdrawals (a "first-mover advantage" dynamic) (International Monetary Fund (IMF), 2022a). Such feedback loops have been shown to increase the likelihood of investor runs and asset fire sales in open-ended funds, posing potential threats to broader financial stability. Consistent with these observations, regulators like the International Organization of Securities Commissions (IOSCO) and FSB have issued policy recommendations specifically aimed at reducing liquidity mismatches in open-ended funds (Financial Stability Board (FSB), 2017; International Organization of Securities Commissions (IOSCO), 2018), reinforcing the rationale to focus on this segment for stress testing.

For selection of funds, investment funds established before 2018 and with complete information disclosure of fund activities are selected to ensure that the sample has enough observations for quantitative studies to produce reliable estimations and findings. In more detail , focusing on those funds means each fund in the study has at least four to five years of history within the 2013–2021 window and excluding funds launched after 2018 reduces the risk of skewing the results with startup-period anomalies (such as initial launch inflows or outsized early performance), thereby avoiding backfill biases. Accordingly, out of 34 open-ended funds and 7 domestic ETFs operating on the Vietnamese stock market by 2021, only 14 investment funds met the sample selection criteria above. Detailed information about the studied investment funds is provided in Table 1.

For the choice of sample period, the study utilizes monthly data from 2013 to 2021 to ensure a sufficiently long and representative time series that includes both normal market conditions and significant stress events. A nearly nine-year span is in line with prior research and regulatory stress test exercises that often use a decade or more of data to capture cycles and tail events. The sample's starting point, 2013 aligns with the global financial event commonly known as the "taper tantrum," when emerging markets including Vietnam experienced substantial capital flow volatility as global investors withdrew capital among fears of rising U.S. interest rates (International Monetary Fund (IMF), 2017b). Furthermore, the endpoint of the sample (2021) strategically encompasses the severe liquidity shock caused by the COVID-19 pandemic in early 2020. The pandemic represented one of the most profound global liquidity crises for investment funds. Vietnamese financial markets and investment funds witnessed increased redemption pressures, heightened volatility, and rapid reallocation of investor portfolios, which underscored potential liquidity mismatches and vulnerabilities unique to Vietnam's relatively shallow and retail-investor-driven financial market. The inclusion of this period ensures the robustness of liquidity stress testing by analyzing fund behaviors during one of the most severe real-world stress scenarios faced by Vietnamese funds.

For selection of funds, investment funds established before 2018 and with complete information disclosure of fund activities are selected to ensure that the sample has enough observations for quantitative studies to produce

reliable estimations and findings. Accordingly, out of 34 open-ended funds and 7 domestic ETFs operating on the Vietnamese stock market by 2021, only 14 investment funds meet the sample selection criteria above. Detailed information about the studied investment funds is provided in Table 1.

Table 1. Summary of the research sample

Investment funds		Year of establishment	Dataset		
Code	***Full name***		**Frequency**	**Start**	**End**
VFMVF1	Vietnam securities investment fund	2013	Monthly	2013m11	2021m6
VCAMBF	Vietnamese balanced investment fund	2014	Monthly	2015m12	2021m6
VCBFTBF	Strategic balanced investment fund - VCBF – TBF	2013	Monthly	2013m12	2021m6
VCBFBCF	Top Equity Fund VCBF	2014	Monthly	2013m12	2021m6
VEOF	Hung Thinh Vina wealth stock investment fund	2014	Monthly	2015m11	2021m6
MAFEQI	Manulife stock investment fund	2014	Monthly	2014m10	2021m6
BVFED	Baoviet dynamic stock investment fund	2016	Monthly	2014m1	2021m6
VFMVF4	Vietnam's leading corporate investment fund (VF4)	2013	Monthly	2013m12	2021m6
MBVF	MB capital value investment fund	2014	Monthly	2015m12	2021m6
SSISCA	Sustainable competitive advantage investment fund SSI	2014	Monthly	2014m9	2021m6
ENF	Eastspring investments dynamic investment fund – ENF	2014	Monthly	2014m3	2021m6
VFMVSF	Vietnam stock investment fund	2013	Monthly	2018m3	2021m6
BVFF	Bao Thinh Vinawealth bond investment fund – VFF	2013	Monthly	2015m12	2021m6
VFMVN30	VFM VN30 ETF	2014	Monthly	2016m3	2021m6
SSIAMVNX50		2017	Monthly	2017m7	2021m6

For data collection, month-end data on net capital flows (capital inflows and outflows), TNA, and asset categories of investment portfolios are collected from monthly financial statements available on the websites of each fund. The use of monthly data is justified by practical availability and precedent in the literature. Previous literature has noted that in most cases only monthly flow data can be obtained, and this frequency has been widely adopted in empirical mutual fund studies (Bouveret, 2017). The monthly data strike a balance by smoothing out day-to-day volatility while still reflecting meaningful shifts in flows and portfolio metrics. For the choice of key variables, capital flows are directly indicative of investor sentiment and redemption pressures, thus serving as a primary indicator for assessing immediate liquidity stress and potential asset sales under extreme market conditions (Chen, Goldstein, & Jiang, 2010; Coval & Stafford, 2007). Total Net Assets (TNA) captures the relative scale and capacity of funds, essential for gauging the impact of redemptions on fund liquidity and facilitating comparisons across funds of varying sizes (Bouveret, 2017; International Monetary Fund (IMF), 2017b). Asset category composition reflects underlying portfolio liquidity; funds invested predominantly in less liquid securities such as corporate bonds or small-cap equities are more vulnerable during redemption shocks, amplifying systemic liquidity risks (Goldstein, Jiang, & Ng, 2017).

3.2. Research Methods

This study following Bouveret (2017), European Securities and Markets Authority (ESMA) (2019a) and European Securities and Markets Authority (ESMA) (2019b) examines and assesses LST of investment funds in Vietnam with a three-step process presented below coupled with the support of software R (version 4.1.2) and RStudio (version 1.3.1093). Besides, this study performs LST for each fund rather than using an aggregated LTS for all funds in a fund family or all funds in the entire investment fund industry since the former approach is believed to produce more statistical value as well as practical significance than the latter (AMIC & EFAMA, 2019; Bouveret, 2017; European Securities and Markets Authority (ESMA), 2019a).

3.2.1. Step 1: Redemption Shocks

A single fund's redemption shock is determined by finding the probability of the worst net withdrawal flow of each investment fund where the capital outflows of investors prevail over the investor's investment inflows into the investment fund. Therefore, it is necessary to determine the net capital flow, which is calculated as follows to determine the extreme net withdrawal scenario of the fund:

$$Cash\ flow1_t = inflow_t - outflow_t$$
$$dt1_t = Cash\ flow1_t / TNA_t \quad (1)$$

Where "dt1" is the ratio of net capital investment to the total net asset value (TNA) of the investment fund.

In the case that the data on cash inflow and outflow of the fund is missing, the calculation of "cash flow" and "dt" are performed, according to Coval and Stafford (2007), data on cash inflow and outflow of the fund is missing, the calculation of "cash flow" and "dt" are performed with the following formula:

$$Cash\ flow\ 2_t = TNA_t - TNA_{t-1} \times (1 + R_t)$$
$$dt2_t = Cash\ flow2_t / TNA_t \quad (2)$$

In this study, the calculation of net cash flow by methods is performed and used simultaneously in determining the liquidity shock of the fund as one robustness approach of the research.

After dt1 and dt2 are calculated, the liquidity shock (liquidity stress/redemption pressure) is identified based on the historical data distribution of dt1 and dt2. Non-parametric methods (using percentiles) and parametric methods (using quantitative models, Monte Carlo simulations) are used to determine VaR (Value at Risk) and ES (Expected Shortfall) for each investment fund at the significance levels of 0.1%, 1% and 5%. Although the ES measure more accurately reflects the redemption pressure, both VaR and ES are calculated in this study for robust comparison of the results.

The estimated value of VaR and ES at each level of statistical significance of $\alpha\ is$ A%. This indicates there is α percent of changes that an investment fund will be exposed to a risk of a net outflow of at least A% of the total net asset value of the fund in the upcoming period. To put it another way, it is (100% - α) certain that in the next period, the investment fund will be exposed to at most A% net outflow of the total net asset value of the investment project next month.

3.2.1.1. Non-Parametric Method

VaR at a specific α significance level is equivalent to determining the α percentile in the original data distribution of the net capital flows of the investment (dt1, dt2).

$$\text{VaR}(\alpha) = F^{-1}(\alpha) \quad (3)$$

Where $F^{-1}$is the inverse of the distribution function. Specifically, for each net inflow, the VaR at the 5% significance level is equivalent to the 5th percentile, the lowest of the fund's net inflows.

ES measures the average value of net capital flows that are worth less than the estimated VaR. Specifically, ES is calculated as follows:

$$\text{ES}(\alpha) = \frac{1}{\alpha}\int_0^{\alpha} VaR(l)dl \quad (4)$$

$$\text{ES}(\alpha) = E(Z|Z < VaR(\alpha)) \quad (5)$$

Thus, the ES at a 5% significance level is the mean of net capital flows that are less than the value at the 5th percentile of the data distribution in the left tail of the data distribution.

3.2.1.2. Parametric Method

The determination of VaR and ES will follow a specific distribution function of the data:

$$VaR = \mu_p - z_a \times \sigma_p \quad (6)$$

Where

$\mu_p$is the average expected value of "dt1" and "dt2".

$\sigma_p$is the standard deviation of "dt1" and "dt2".

z_a: Critical value (one-sided confidence interval).

As shown above, dt1 and dt2 are net capital inflows (inflows and outflows) of the investment, therefore a positive value of dt1 indicates a net inflow status and a negative value of dt1 indicates a negative state of capital inflow. From the historical data distributions of "dt1", "dt2", VaR will be on the left end of the distribution, reflecting the net capital outflow or redemption pressure of a fund.

Furthermore, the Monte Carlo simulation method is employed to expand the sample size with 10000 iterations based on characteristics of the original sample (μ_p, σ_p) with a limited research database. Afterwards, the non-parametric method is utilized to determine the redemption shock (VaR and ES)

The qualitative modelling approach is applied along with the parametric model (built up from sample mean and variance) and the Monte Carlo simulation to provide another layer of robustness check. Some previous literature has suggested that based purely on the sample characteristics of μ_p, σ_p is not completely reliable because the mean and standard deviation of the net capital flows of the investment portfolio can change over time, therefore, the use of quantitative models to predict the value (μ_p, σ_p) then fit into Equation 6 would be more reasonable.

Therefore, some models are used to predict the mean value of the research sample such as ARMA (p, q), and predict the standard deviation of the research sample such as Garch (1,1) (temporarily called *"parametric model 2"* in this study, or the RiskMetrics model (temporarily referred to as *"parametric model 1"* in this study) was developed by JP Morgan with the assumption that $\mu_p = 0$, σ_p being predicted through iGarch model (1,1) (Morgan, 1996).

Morgan (1996) and the European Securities and Markets Authority (ESMA) (2019a) have recommended that among the discussed methods of producing VaR and ES, it would be more valuable in practical aspects to use the historical dataset reflecting actual operations of investment funds and their cash flow movements to provide reliable assessments on future liquidity stress. This supports non-parametric and Monte Carlo simulations.

3.2.2. Step 2: Liquidity Buffer

Following Bouveret (2017) and the International Monetary Fund (IMF) (2017a), this study uses two-tiered approaches to assess the liquidity buffer of an investment fund.

Approach 1: Liquidity buffer is defined as the ratio of cash and cash equivalents (current deposits and short-term deposits at commercial banks) to the total net asset value of the fund. This variable is denoted "total cash" in this study.

Approach 2: Liquidity buffer is determined according to the asset pillars of the investment portfolio of the fund (*High-Quality Liquid Assets (HQLA)*). Under the HQLA approach, the value of the fund's assets is adjusted to the level of liquidity asset ratio.

$$Liquidity\ asset\ ratio_t = \sum_{k=1}^{n} w_k \times s_{t,k} \quad (7)$$

Where w_k is the liquidity weight of the asset group k; $s_{t,k}$ represent the market share of the asset class k in the total net asset value of the investment fund; t denotes time.

In Vietnam, there is no legal document regulating or guiding the calculation of risk-adjusted asset value or the ratio of liquid assets. Therefore, in this study, we determine the liquidity weight *(w)* of each asset class as follows:

First proxy of the liquidity weight *(w)* of each asset category is determined based on the method of determining risk weights specified in *Circular 226/2010/TT-BTC dated December 31, 2010 regulating prudential measures applicable to securities business organizations* and *Circular No. 165/2012/TT-BTC dated October 9, 2012 amending and supplementing a number of articles of Circular No. No. 226/2010/TT-BTC.*

Accordingly, liquidity weight for cash, government bonds, stocks, and corporate bonds are 100%, 85% (100% minus the average of 10%, 15% and 20%), and 77 % (100% minus the average of 6 risk factors 8%, 15%, 20%, 25%, 30% and 40%), respectively. These weights are used to calculate the liquidity asset ratio " liq1 ".

The alternative proxy is adopted from Bouveret (2017). The cash and cash equivalents asset categories are weighted at 100%. Government bonds are also considered to be 100% liquid and stocks are 50%. For corporate bonds, an average of 85% and 50% recommended in Bouveret (2017) is used due to the lack of corporate bond ratings in. Then, the ratio of liquid assets is calculated and denoted as "liq2".

3.2.3. Step 3: Fund's Resilience against Its Liquidity Stress

The study followed Bouveret's (2017) measures of the resilience of investment funds to liquidity shocks through the Redemption Coverage Ratio (RCR) (see Equation 8). The ratio reflects the ability of the fund's liquidity buffer to cover investors' redemption requests of fund units in the most unfavorable scenario.

$$RCR_t = Liquid\ Assets/Net\ Outflows \quad (8)$$

If RCR is larger than 1, this evidences that the fund has enough liquid assets to respond to a liquidity shock. If the RCR is less than 1, the fund must sell managed assets, possibly at a discount, to finance the redemption of fund units. If the selling pressure from the fund is too large, it will greatly affect the market liquidity of assets and their market prices and may cause spillover effects to other investors' investment behaviours and decisions in the market. Therefore, for funds with RCR less than 1, the (LS) and the share of liquidity shortfall to total net asset value (LS/TNA) will be further calculated (see Equation 9).

$$LS = Net\ outflows - Liquid\ Asset \quad (9)$$

The details of those above variables are as follows in Table 2.

Table 2. Variable description

Notation	Variable names	Description
TNA	Total net asset value	Financial statements of investment funds
dt1	Ratio of net cash flow (net inflow) to TNA	Equation 1
dt2		Equation 2
-dt1	Ratio of net cash flow (net outflow) to TNA	dt1*(-1)
-dt2		dt2*(-1)
Total cash	Ratio of cash, cash equivalents to TNA	(Total cash + cash equivalents + current deposit + term deposit)/TNA
liq1	Ratio of liquid assets to TNA (liquidity buffer)	Equation 7 using R software, method 1 of finding w.
liq2		Equation 7 using R software, method 2 of finding w
RCR _total cash	Redemption coverage ratio (RCR)	Equation 8 with numerator total cash, using R
RCR_liq1		Equation 8 with numerator liq1, using R
RCR_liq2		Equation 8 with numerator liq1, using R
VaR	Value at risk (extreme net outflow to total assets)	Equation 3 and Equation 6 using R, R measure and code
ES	Expected shortfall (conditional risk value)	Equation 4 and Equation 5 using R, R measure and R code
LS	Liquidity shortfall	Equation 9

4. RESULTS AND DISCUSSIONS

4.1. Redemption Shock

The results of estimating VaR and ES from different methods are summarized in Table 3, panel A. However, the research focuses on analyzing liquidity shocks of investment funds according to the robust estimates from the Monte Carlo simulation with a relatively limited sample size (see Table 3 and panel B).

Table 3. Redemption shock range of all funds

Panel A. Redemption shock range: 5% significance level					
Funds	**VaR**	**ES**	**Fund**	**VaR**	**ES**
VFMVF1	12.9% - 14.7%	15.8% - 18.3%	MBVF	11.9% - 36.3%	15% - 48.6%
VCAMBF	0.5% - 2.1%	1.4% - 2.4%	SSISCA	7.3% - 9.7%	12.3% - 14.6%
VCBFTBF	3.1% - 6.2%	6% - 7.7%	ENF	0.8% - 3.9%	2.3% - 5%
VCBFBCF	7% - 8.3%	8.7% - 10.6%	BVFF	12.4% - 20.5%	15.4% - 26.5%
VEOF	7.9% - 13.7%	10.3% - 17.5%	VFMVSF	5.5% - 26.9%	8.2% - 35.0%
MAFEQI	2.4% - 3.5%	2.7% - 4.7%	VFMVN30	7.7% - 13%	13.8% - 17.3%
BVFED	3.1% - 5.5%	4.6% - 6.8%	SSIAMVNX50	0% - 4.1%	4.9% - 5.1%
Panel B. Redemption shock: 5% significance level, Monte Carlo simulation					
Fund	VaR	ES	Fund	VaR	ES
VFMVF1	12.9%	15.8%	MBVF	32.1%	39.7%
VCAMBF	1.9%	2.4%	SSISCA	9.7%	12.3%
VCBFTBF	5.7%	7.2%	ENF	3.9%	5.0%
VCBFBCF	8.3%	10.6%	BVFF	20.5%	26.5%
VEOF	13.7%	17.5%	VFMVSF	26.9%	35.0%
MAFEQI	3.5%	4.7%	VFMVN30	13.0%	17.3%
BVFED	5.5%	6.8%	SSIAM VNX50	3.9%	5.1%

According to the estimated VaR, 57.14% out of the total number of investment funds in the sample at 95% confidence are likely to suffer a maximum net withdrawal of less than 10% TNA, including VCAMBF, MAFEQI, SSIAVN50, ENF, BVFED, VCBFTBF, VCBFBCF, and SSISCA. The first 4 funds have the risk of net capital withdrawal estimated to appear in the next month at less than 5%. This partly reflects the operational structure of the investment projects as well as the attractiveness of the investment objectives and investment strategy of the investment plans. For example, in the case of MAFEQI, the capital inflow into the fund is mainly from periodic insurance premiums from the policy clients. Therefore, it is relatively stable while the capital outflow from the investment fund is relatively limited. Since the emergence and unprecedented developments of the COVID-19 pandemic, people's health risks have increased, encouraging a number of consumers of financial products actively accessing and purchasing insurance products. This rising demand for insurance products eventually creates a remarkable contribution to the expansion and enhancement of the value of investment funds run by insurance firms. Vietnam report's survey results show that 71% of insurers in Vietnam agree that the COVID-19 pandemic has contributed positively to promoting the improvement of people's awareness and understanding of insurance products. Meanwhile, only 11% of the population will participate in at least 1 insurance product by the end of 2020 (Linh, 2021). This number is expected to increase to 15% by 2025. This lays a solid foundation for the development of investment funds in the form of an investment insurance-linked product of insurers. Additionally, the noticeable prevalence of these investment funds with long-term investment objectives will have a positive impact on the stability of the stock market as well as increase the market's ability to withstand domestic and international financial shocks with a relatively low liquidity shock relative to total net asset value.

In contrast, 37.5% of investment funds in the research sample are likely to face redemption shocks greater than 10%, particularly 12.5% of investment funds (BVFMVFS and MBVF, of which the former is a bond fund) have the risk of experiencing a liquidity shock of more than 20%, particularly from 27% to 40% of TNA. Besides, the results of the liquidity shock of ETFs of leading investment management companies (Vietnam Fund Management with VFMVN30, SSI Asset Management with SSIAM VNX50) are somewhat lower than that of other active equity funds.

Table 4. Percentage of funds in the sample at different redemption pressures

Predicted net outflows to the total net value	Less than 10%	From 10% to 20%	Over 20%
VaR	57.14%	25.00%	12.50%
ES	37.50%	31.25%	18.75%

In addition, the research results also show that similar to Bouveret (2017), International Monetary Fund (IMF) (2017a), European Securities and Markets Authority (ESMA) (2019a) and AMIC & EFAMA (2019), the estimation of redemption shocks obtained from the ES measure is significantly larger for the VaR approach (see Table 4). This suggests that simply using VaR could ignore the extreme liquidity shocks emerging on the tail of the net capital outflow distribution and this can lead to somewhat looser liquidity risk management tools and relaxed regulation of investment funds compared to recommendations led by risk assessment on ES.

While VaR statistics show that up to 57.14% of investment funds are likely to experience shocks of less than 10% of NAV, the corresponding ES is merely 37.5%. This implies that according to ES, more funds are exposed to higher redemption shock levels. Therefore, the use of ES estimation results to measure redemption shock and liquidity stress of investment funds will contribute to more conservative risk judgments on an investment fund's performance, which helps fund managers and policy makers to formulate appropriate risk management policies.

4.2. Investment Fund's Resilience against Liquidity Stress

Comparing indicators liq1 and liq2 (see Table 5), it is easy to see that the ratio of liquid assets of the fund to total net asset value according to the first calculation method (liq1) is always higher than that of liq2 since the liquidity weight of equity securities in liq1 is 85%, higher than the 50% level in liq2 as recommended by Bouveret (2017). Although there is a significant difference between RCR_liq1 and RCR_liq2 values, the resilience of the investment funds against liquidity risk are both higher than 1, reflecting sufficient liquidity risk tolerance of investment funds.

Table 5. Liquidity ratio and liquidity buffer of investment funds

Investment Fund	liq1	liq2	Total cash	VaR*	ES*	RCR_liq1	RCR_liq2	RCR_total cash
VCAMBF	85.3%	63.7%	31.9%	1.9%	2.4%	5.395	4.029	2.017
MAFEQI	85.0%	52.7%	6.5%	3.5%	4.7%	5,373	3,330	0.411
SSIAM VNX50	85.0%	51.0%	2.4%	3.9%	5.1%	5.374	3.223	0.152
ENF	89.8%	69.1%	28.9%	3.9%	5.0%	5.674	4.369	1.827
BVFED	84.8%	56.7%	16.4%	5.5%	6.8%	5.358	3.585	1.036
VCBFTBF	85.1%	62.9%	25.9%	5.7%	7.2%	5,383	3.974	1.637
VCBFBCF	85.6%	56.3%	13.9%	8.3%	10.6%	5.412	3.557	0.881
SSISCA	85.9%	57.1%	14.8%	9.7%	12.3%	5.431	3.608	0.936
VFMVF1	77.8%	49.2%	6.7%	12.9%	15.8%	4.921	3.113	0.422
VFMVN30	84.9%	50.7%	1.8%	13.0%	17.3%	5.366	3.203	0.114
VEOF	85.3%	55.1%	10.3%	13.7%	17.5%	5.395	3.482	0.649
BVFF	87.8%	85.9%	56.7%	20.5%	26.5%	5.548	5.428	3.586
VFMVSF	85.1%	52.7%	6.3%	26.9%	35.0%	5,382	3.329	0.395
MBVF	94.2%	74.9%	45.8%	32.1%	39.7%	5.952	4.732	2.893

Note: * Redemption shock by Monte Carlo simulation, significance level 5%.

A more prudent assessment of the fund's response to the liquidity stress scenario with the support of "total cash" (cash and deposits, cash equivalents, hereinafter collectively referred to as cash).

Some funds are likely to experience less liquidity stress, yet possess an excessive reserve of cash (VCAMBF, ENF, VCBFTBF and BVFED). Cautiously holding excess cash at a relatively high level could cause RCR to be significantly larger than the ideal level of 1.0, which can waste the financial resources of investment funds, particularly the fund investors, in allocating the fund's managed assets into more profitable asset categories.

Some investment funds are at relatively low risk of capital withdrawal (MAFEQI and SSIAM VNX50) and a medium level of redemption risk (VCBFBCF and SSISCA), yet at the same time also maintain an extremely low cash ratio, limiting the fund's ability to respond quickly to liquidity shocks. These funds will face the risk of unintentionally selling a part of their investment portfolio with only a small liquidity shock. This can affect the

efficiency of investment management when the investment fund is forced to divest part of the current portfolio that may be profitable in the long term.

Investment funds are likely to face a high redemption risk (BVFF and MBVF), a risk of fund withdrawal from about 20% to 50% of TNA, but are more resilient to expected future liquidity shocks, not only based on the RCR_liq1 and RCR_liq2 measures, but also with a more conservative measure (RCR_total cash). These investment funds should also consider liquidity risk management tools to reduce the risk of liquidity shocks instead of holding a sizable amount of cash, limiting the profitability of the investment portfolio as well as the fund's overall performance.

5. CONCLUSION AND MANAGERIAL IMPLICATIONS

The study has successfully quantified and diagnosed the redemption shocks coupled with the liquidity stress of investment funds in Vietnam. The research findings assert the current safe phases of investment funds with a majority of funds enjoying lower exposure to withdrawal shocks from investors. The nature of ETFs has proved their lower liquidity stress in comparison with open-end funds, especially when a large number of open-end funds in Vietnam are offering investors with a high trading frequency (daily).

The results of the resilence examination have also revealed the undesirable allocation of managed assets of the fund into different asset types, especially into cash and equivalents. Notably, some funds' cash holdings are not equivalent to the expected liquidity stress of the funds which could cause the fund to lose profitability and inefficiencies in liquidity management practices. This calls the funds for applying a liquidity stress testing model to identify the appropriate holdings of cash and equivalents to efficiently balance between the purpose of generating profits for investors of the funds and the target of fully controlling the liquidity stress from the fund's operation. These insights not only aid individual fund managers in enhancing portfolio efficiency by enabling more strategic and efficient allocation of assets but also provide policymakers and regulators with robust empirical evidence to develop informed regulatory frameworks and guidelines. Policymakers can use these findings to establish clearer standards and best practices for liquidity management while regulators can incorporate stress-testing requirements into the existing regulatory oversight process. Ultimately, this comprehensive approach will significantly contribute to a more stable and resilient fund management industry in Vietnam, thereby enhancing investor confidence and supporting the sustainable growth of the country's financial markets.

Although certain results have been obtained, this quantitative research has several limitations that can be improved in future studies. First, the study sample is small in terms of both the number of investment funds that meet the sampling conditions and the limited time frame of data due to a number of newly established and operated funds, especially since 2020 and 2021. The limited observations may somewhat affect the reliability of the VaR and ES estimations, except for the Monte Carlo simulation method. Second, the determination of liquidity weights for asset classes currently does not have any unified legal regulations. In this study, we rely on Bouveret (2017) and the most relevant regulation - Circular 226/2010/TT-BTC to set the liquidity weights for different asset categories. Therefore, to agree on the calculation method, to serve the unified disclosure of information to investors, as well as to serve the application of this liquidity stress tests on Vietnam's investment funds on a regular basis to timely detect the risk of financial failure, it is necessary to have a uniform regulation on the liquidity weights of assets.

Funding: This research is supported by the Banking Academy of Vietnam (Grant number: 4990/TB-HVNH).
Institutional Review Board Statement: Not applicable.
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Competing Interests: The authors declare no conflict of interest.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and approved the final version of the manuscript.

REFERENCES

AMIC & EFAMA. (2019). *AMIC/EFAMA report on liquidity stress tests in investment funds. European Fund and Asset Management Association.* Retrieved from https://www.icmagroup.org/assets/documents/Regulatory/AMIC/AMIC-EFAMA-joint-paper-on-liquidity-stress-tests-in-investment-funds-January-2019-08012019.pdf

Arora, R., Bédard-Pagé, G., Leblanc, G. O., & Shotlander, R. (2019). *Bond funds and fixed-income market liquidity: A stress-testing approach (Technical Reports Vol. 115). Bank of Canada.* Retrieved from https://www.bankofcanada.ca/wp-content/uploads/2019/04/tr115.pdf

Bouveret, A. (2017). *Liquidity stress test for investment funds: A practical guide. International Monetary Fund.* Retrieved from https://www.elibrary.imf.org/view/IMF001/24670-9781484324783/24670-9781484324783/24670-9781484324783.xml?redirect=true

Chen, Q., Goldstein, I., & Jiang, W. (2010). Payoff complementarities and financial fragility: Evidence from mutual fund outflows. *Journal of Financial Economics, 97*(2), 239-262. https://doi.org/10.1016/j.jfineco.2010.03.016

Coval, J., & Stafford, E. (2007). Asset fire sales (and purchases) in equity markets. *Journal of Financial Economics, 86*(2), 479-512. https://doi.org/10.1016/j.jfineco.2006.09.007

Dragon Capital. (2022). *Vietnam monthly market report – November 2022.* Retrieved from https://cdn.dragoncapital.com/media/2022/12/14032337/MR_202211.pdf

European Securities and Markets Authority (ESMA). (2019a). *ESMA economic report – Stress simulation for investment fund.* Retrieved from https://www.esma.europa.eu/sites/default/files/library/esma50-164-2458_stresi_report.pdf

European Securities and Markets Authority (ESMA). (2019b). *Final report – Guidelines on liquidity stress testing in UCITs and AIFs.* Retrieved from https://www.esma.europa.eu/sites/default/files/library/esma34-39-882_final_report_guidelines_on_lst_in_ucits_and_aifs.pdf

Financial Stability Board (FSB). (2017). *Policy recommendations to address structural vulnerabilities from asset management activities.* Retrieved from https://www.fsb.org/wp-content/uploads/FSB-Policy-Recommendations-on-Asset-Management-Structural-Vulnerabilities.pdf

Goldstein, I., Jiang, H., & Ng, D. T. (2017). Investor flows and fragility in corporate bond funds. *Journal of Financial Economics, 126*(3), 592-613. https://doi.org/10.1016/j.jfineco.2016.11.007

International Monetary Fund (IMF). (2015). *Stress testing – Technical note. United States Financial Sector Assessment Program (IMF Country Report No. 15/173). Washington, D.C.: IMF.* Retrieved from https://www.imf.org/en/Publications/CR/Issues/2016/12/31/United-States-Financial-Sector-Assessment-Program-Stress-Testing-Technical-Notes-43058

International Monetary Fund (IMF). (2017a). *Luxembourg: Financial system stability assessment (IMF Country Report No. 17/122). Washington, D.C.: IMF.* Retrieved from https://www.imf.org/en/Publications/CR/Issues/2017/05/15/Luxembourg-Financial-System-Stability-Assessment-44907

International Monetary Fund (IMF). (2017b). *Global financial stability report October 2017: Is growth at risk?* Retrieved from https://www.imf.org/en/Publications/GFSR/Issues/2017/09/27/global-financial-stability-report-october-2017

International Monetary Fund (IMF). (2022a). *How illiquid open-end funds can amplify shocks and destabilize asset prices.* Retrieved from https://www.imf.org/en/Blogs/Articles/2022/10/04/how-illiquid-open-end-funds-can-amplify-shocks-and-destabilize-asset-prices

International Organization of Securities Commissions (IOSCO). (2018). *Open-ended fund liquidity and risk management – Good practices and issues for consideration.* Retrieved from https://www.iosco.org/library/pubdocs/pdf/IOSCOPD591.pdf

Linh, V. (2021). *Covid-19 creates a "turning point" for insurance companies. CafêF.* Retrieved from https://cafef.vn/covid-19-tao-nen-cu-chuyen-minh-cho-doanh-nghiep-bao-hiem-20210923205227675.chn

McKenzie, B. (2020). *Liquidity risk management in investment funds 2020: Singapore chapter.* Retrieved from https://www.imas.org.sg/public/media/2020/01/06/1794_Baker_Mckenzie.Wong_Leow_-_Asia.pdf

Monetary Authority of Singapore (MAS). (2018). *Guidelines on liquidity risk management practices for fund management companies.* Retrieved from https://www.mas.gov.sg/-/media/mas-media-library/regulation/guidelines/cmg/guidelines-sfa-04-g08-liquidity-risk-management-practices-for-fund-managers/guidelines-on-liquidity-risk-management-practices-for-fmcs-1-aug-2024.pdf\

Morgan, J. (1996). *RiskMetrics - technical document* (4th ed.). New York: JP Morgan & Co.

Reuters. (2024). *EM bond funds see largest weekly outflow in two years, JPMorgan report says.* Retrieved from https://www.reuters.com/markets/rates-bonds/em-bond-funds-see-largest-weekly-outflow-two-years-jpmorgan-report-says-2024-11-08/

Wells Fargo & Company. (2015). *Annual company-run stress test results under the Federal Reserve's assumed severely adverse scenario.* Retrieved from https://www08.wellsfargomedia.com/assets/pdf/about/investor-relations/stress-test-results/2015-annual-stress-test.pdf