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Cash optimization with cash management model approach: The case of PT Pertamina Gas (Pertagas)

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ABSTRACT

This study examines the optimization of corporate cash management at Pertagas amid heightened volatility in the energy sector, fluctuating exchange rates, inflationary pressures, and internal demands for CapEx–OpEx efficiency. Using a quantitative approach, this research evaluates Pertagas's cash cycle and liquidity profile, and applies five cash management models—Baumol, Beranek, Miller-Orr, Stone, and Orgler—to determine optimal cash balances under varying assumptions of certainty and uncertainty. Results indicate substantial volatility in net cash flows, with a Value at Risk (VaR) of –USD 81.48 million at the 95% confidence level. Model estimations recommend optimal daily cash levels ranging from USD 1.05 million (Baumol) to USD 4.51 million (Miller-Orr), significantly lower than the company's existing Rp 200 billion (≈ USD 12.5 million) policy threshold, implying notable opportunity costs from holding idle cash. The Orgler model further shows that Pertagas could generate up to USD 10.89 million annually through optimized deployment of surplus liquidity. The study recommends integrating stochastic and forecasting-based models, strengthening cash monitoring systems, and revising minimum cash policies to enhance liquidity, profitability, and financial resilience.

INTRODUCTION

Cash management is a fundamental component of corporate finance, as it involves the processes of collecting, disbursing, and managing cash to ensure the continuous liquidity of the firm. Operationally, effective cash management ensures that sufficient funds are available to meet short-term obligations while optimizing the use of excess cash through profitable short-term investments (Jiang & Wu, 2022). Beyond preventing financial distress, sound cash management minimizes funding costs, accelerates cash inflows, and enhances overall working capital efficiency. Its importance becomes even more pronounced in the presence of cash-flow uncertainty, where fluctuations between inflows and outflows require the firm to maintain an adequate minimum cash balance while investing surplus cash to avoid opportunity costs (Mensah et al., 2024).

PT Pertamina Gas (Pertagas), as part of the Gas Subholding of PT Pertamina (Persero), operates within a highly dynamic and uncertain energy business environment. By 2024, Pertagas continued to strengthen its position through the expansion of national gas infrastructure—reaching 13,319 km—and an increase in total customers to 821,245. The company has also contributed to national decarbonization initiatives and exceeded its annual carbon reduction target by achieving a reduction of 1.29 million tons of CO_2. However, as outlined in the 2023 Board of Directors Report, Pertagas faces major external challenges stemming from global energy price volatility, exchange-rate fluctuations, and inflationary pressures. These factors directly elevate cash-flow uncertainty, exert pressure on liquidity, and hinder the firm's ability to maintain an efficient cost structure.

The combined effects of volatile energy prices, exchange-rate movements, and global inflation reinforce the urgency of implementing an adaptive cash management strategy for Pertagas. Energy price volatility can cause unpredictable cash inflows, while currency depreciation and rising inflation increase cash outflows, particularly for foreign-currency-denominated transactions (Dokas et al., 2023). Under these conditions, cash management becomes a critical risk-mitigation mechanism for ensuring liquidity, meeting short-term obligations, and optimizing fund allocation through scenario-based planning. Practices such as cash-flow forecasting, minimum cash-buffer determination, and volatility-driven risk assessment enhance the company's capacity to maintain financial resilience amid external uncertainties.

Beyond these external challenges, Pertagas also faces internal pressures related to optimizing capital expenditure (CapEx) and operational expenditure (OpEx). Achieving cost efficiency without compromising operational quality requires cash management to play a strategic role in prioritizing expenditures, scheduling investment payments, and allocating funds for routine activities. Approaches such as zero-based budgeting and activity-based budgeting may assist the firm in ensuring that every expenditure contributes to value creation. The effectiveness of internal cash management therefore directly supports the company's ability to sustain operational efficiency and long-term growth.

Toward the end of 2024, Pertagas experienced an excess cash situation in which the company's cash holdings exceeded its daily operational requirements. Although this condition presents an opportunity to place funds in low-risk and liquid short-term instruments, the company's cash-management strategy had not yet been fully optimized. Current practices still rely heavily on historical data, without the application of quantitative cash-management models such as Baumol, Beranek, Miller-Orr, Stone, and Orgler. The use of such models is essential to determine optimal cash balances that balance liquidity risk with investment potential.

In response to these challenges, this study aims to evaluate Pertagas's cash-management cycle, identify limitations in its existing cash-management approach, and formulate an optimal cash-management strategy using established quantitative models. By analyzing the firm's cash flows and assessing financial risks, the study provides strategic recommendations to improve cash-management effectiveness, maintain liquidity, and maximize returns from excess cash holdings (Abensur & de Carvalho, 2022). Through this analytical approach, Pertagas is expected to enhance its financial stability and operational sustainability amid the increasingly complex dynamics of the energy industry.

LITERATURE REVIEW

Corporate Finance

Corporate finance is a field of study that centers on how firms manage their financial resources to achieve strategic objectives, including maximizing firm value for shareholders. Within this discipline, three core decision areas dominate: investment, financing, and risk management. Investment decisions involve allocating funds to projects or assets that are expected to generate future returns, while financing decisions pertain to determining the optimal capital structure—balancing debt, equity, or hybrid instruments to support operations and long-term growth (Bui et al., 2020). These decisions must be aligned with broader corporate strategies, ensuring that financial choices contribute to sustainable value creation.

Corporate financial strategy must also consider external influences such as market conditions, interest rate movements, and global economic risks. A key principle guiding financial management is the pursuit of profit maximization while effectively managing risk exposure (Klychova et al., 2021). Comprehensive evaluation of financial performance—including ratio analysis and other diagnostic tools—plays an essential role in informed decision-making. In an increasingly dynamic and unpredictable business landscape, firms are required to continuously refine their financial strategies to remain competitive and responsive to environmental shifts.

Several dimensions define the broader scope of corporate finance, including capital budgeting, capital structure, working capital management, dividend policy, and risk management. In parallel, companies face rising expectations regarding corporate social responsibility and sustainability. Over the past decades, environmental, social, and governance (ESG) considerations have gained prominence as integral components of financial decision-making. This approach requires firms not only to manage financial risks but also to address non-financial risks related to reputation, regulation, and societal impact. As a result, modern corporate finance integrates a holistic analytical framework to ensure business decisions align with long-term sustainability principles (Chew, 2024).

Cash Management

Cash management refers to the process of managing cash inflows and outflows to ensure that a firm maintains sufficient liquidity to meet its short-term obligations (Nasimiyu, 2024). Effective cash management is essential for ensuring smooth operational continuity, minimizing funding costs, and maximizing the returns generated from excess cash. Stable cash flows allow firms to avoid operational disruptions and exploit profitable short-term investment opportunities (Anorue & Ugwoke, 2022).

Efficient cash management therefore requires careful planning of cash movements, maintaining appropriate cash balances, and optimizing the use of available financial resources.

To anticipate future liquidity needs, companies must develop accurate cash-flow forecasts that account for factors such as seasonality, changes in customer payment behavior, and fluctuations in operating costs. Managing liquidity risk often involves establishing cash reserve policies that consider multiple scenarios and uncertainty levels (Chakraborty et al., 2017). The adoption of modern cash-management software further enhances a firm's ability to monitor cash positions in real time, enabling faster and more precise financial decision-making.

Another key component of cash management is minimizing idle cash balances. Unused funds can be placed in short-term financial instruments—such as time deposits or money market securities—that yield higher returns compared to holding cash without purpose. However, firms must maintain a prudent balance between liquidity and profitability, as allocating too much cash to investments may elevate liquidity risk (Bhuiyan & Hooks, 2019; Rahaman & Feng, 2023). As a result, effective cash management requires continuous evaluation of operational needs and investment opportunities to achieve optimal outcomes.

Cash management practices also extend to managing relationships with banks and financial institutions. Firms need strong partnerships with banks to secure adequate credit facilities and obtain reliable transaction services. Banking services such as cash pooling and cash concentration help companies optimize balances across various accounts or geographic locations. Through proactive cash management, firms are able to reduce transaction costs, enhance returns, and strengthen financial resilience.

Cash Management Models and Cash Optimization

Determining an optimal cash balance is a key managerial process that enables firms to maintain an appropriate equilibrium between liquidity and profitability. The optimal cash level ensures that a company holds sufficient funds for daily operational needs while avoiding excessively idle balances that generate opportunity costs (Kontuš, 2018). Several well-established approaches—such as the Baumol, Beranek, Miller–Orr, Stone, and Orgler models—are frequently used to guide firms in defining minimum and maximum cash thresholds based on cash-flow volatility and transaction-related considerations.

The Baumol Model, developed by William J. Baumol in 1952, draws from the Economic Order Quantity framework commonly used in inventory management. It assumes that firms replenish their cash balances by withdrawing from interest-bearing investments whenever their cash level falls below a predetermined threshold. The model is most suitable for firms with predictable and stable cash flows, as it emphasizes efficiency in balancing withdrawal costs with returns on short-term investments (Melo & Bilich, 2013). Through this approach, firms can determine an appropriate pattern of cash conversion that supports liquidity without maintaining unnecessarily large idle balances.

The Beranek Model, developed by William Beranek, emphasizes the trade-off between liquidity risk and opportunity cost in cash holding. Instead of relying on a specific mathematical formula, the model conceptualizes optimal cash management as a balance between the costs of holding excessive cash and the transaction costs associated with raising funds when cash levels fall too low (Michalski, 2010). This framework is particularly relevant for firms operating in uncertain environments where

strategic cash allocation must account for market conditions, funding costs, and potential investment opportunities.

Introduced by Merton Miller and Daniel Orr in 1966, the Miller–Orr Model provides a more flexible and realistic approach to cash management by incorporating the stochastic nature of cash flows (Kontuš, 2018). Unlike the Baumol Model, it recognizes that cash flows often fluctuate unpredictably due to operational variability or external shocks. The model defines upper and lower control limits for cash balances, allowing firms to manage volatility while minimizing liquidity risk. This approach is well suited to firms with irregular or highly variable cash inflows and outflows—such as energy and commodity-based companies—where uncertainty is inherent in financial operations.

The Stone Model extends the Miller–Orr framework by integrating cash-flow forecasting techniques. It enhances decision-making by considering both historical cash-flow patterns and forward-looking estimates. By updating control limits based on predicted cash movements, the model enables firms to adjust their cash positions proactively rather than reactively. This approach is particularly valuable for firms with seasonal or irregular cash patterns, allowing them to account for anticipated fluctuations in revenues or expenditures.

Lastly, the Orgler Model represents a multidimensional approach to cash management by integrating cash-balance decisions with broader aspects of working-capital and financing strategies. It often employs simulation or linear programming techniques to formulate optimal policies that align with overall corporate strategy. In doing so, the model incorporates considerations such as minimum–maximum cash thresholds, the use of short-term borrowing, receivables and payables management, and external factors such as interest rates and market conditions. This comprehensive perspective enables firms to optimize cash flows not only through balance management but also through coordinated operational and financing activities.

A variety of external and internal factors further influence optimal cash-balance decisions, including macroeconomic conditions, interest-rate movements, and the firm's business outlook (Farooq et al., 2021; Palazzo, 2012). During periods of heightened uncertainty or elevated interest rates, firms may choose to hold larger cash reserves as a precautionary response. Conversely, in more stable environments, firms may pursue more aggressive deployment of surplus cash. Corporate strategies—such as borrowing policies or access to credit lines—also shape decisions regarding liquidity buffers and cash allocation.

Determining optimal cash levels extends beyond maintaining liquidity; it is also central to enhancing financial efficiency. Firms must periodically evaluate and refine their cash-management policies in response to changes in the external environment and internal operational needs. Data analytics and financial technologies now play a critical role in enabling firms to dynamically measure and adjust optimal cash thresholds. With a robust strategy in place, firms can reduce transaction costs, improve returns on excess liquidity, and uphold financial flexibility.

METHODS

Research Design

This study employs a quantitative research design to determine the optimal cash balance for Pertagas by applying five established cash-management models: the Baumol Model, Beranek Model, Miller–Orr Model, Stone Model, and Orgler Model. The analysis

integrates deterministic and stochastic modeling to evaluate cash-flow volatility, liquidity needs, and the opportunity costs associated with holding excessive cash. The methodological approach is designed to (1) estimate cash-balance limits, (2) quantify optimal cash transfer amounts, and (3) assess firm-level liquidity risk under uncertainty. Data were collected for the most recent fiscal period (January–December 2024), supplemented by internal corporate reports and audited financial statements. The study uses secondary data from Pertagas, including: (1) daily and monthly cash inflows and outflows, (2) historical cash balances, (3) ariable and fixed transaction costs, (4) short-term interest rates and opportunity cost of capital, (5) internal cost structures related to cash transfers, and (6) market indicators and macroeconomic variables affecting volatility

Analytical Procedures

The collected data will be analyzed using several cash-management models, including the Baumol, Beranek, Miller–Orr, Stone, and Orgler models. The Baumol Model will be used to calculate the optimal cash level based on the frequency of fund withdrawals and the rate of return on short-term investments, assuming stable and predictable cash flows. The Beranek Model will be examined to evaluate the influence of transaction costs and liquidity risk on cash-management decisions. The more flexible Miller–Orr Model will be applied to determine the lower limit, upper limit, and return point for cash-balance adjustments, taking into account unexpected cash-flow volatility. The Stone Model will be used to integrate cash-flow forecasting into the cash-management strategy, enabling the company to adjust cash balances based on projected future cash movements. Meanwhile, the Orgler Model will be applied to assess cash management within the broader context of working-capital management, considering factors such as trade credit and accounts-payable policies. The results of these analyses will be used to provide strategic recommendations for optimizing Pertagas' cash position, thereby enhancing the efficiency and effectiveness of financial-resource utilization and ensuring an appropriate balance between liquidity, profitability, and financial-risk management.

Baumol Model

The Baumol Model is applied to estimate the optimal size of cash transfers for firms with relatively predictable cash-flow patterns. The model assumes constant cash usage and constant opportunity cost of capital. The optimal cash balance is calculated using the following formula:

$$C = \sqrt{\frac{2bT}{i}}$$

Where: C is optimal cash transfer size; B is fixed transaction cost per conversion from marketable securities; T is total cash requirement over the period; and i is interest rate or opportunity cost of holding cash.

Beranek Model

The Beranek Model incorporates liquidity-risk trade-offs by balancing the cost of holding excess cash (opportunity cost) and the cost of running out of cash (transaction costs, penalties, and borrowing).

$$n = \sqrt{\frac{iY}{2a}}$$

Where: a refers to the transaction cost; Y refers to the total cash requirement; i refers to the opportunity cost; and n refers to the optimal number of transactions.

Miller-Orr Model

The Miller–Orr Model is applied to estimate optimal cash limits under stochastic cash-flow behavior. The upper limit, return point, and lower limit are computed as follows:

$$U = 3C - 2L$$

$$C = L + \left(\frac{3}{4}\ x\ F\ x\ \frac{\sigma^2}{R}\right)^{1/3}$$

Where: U is the upper limit of the cash balance; L is the lower limit of the cash balance (set by management); C is the target cash balance; F is the transaction cost for adjusting the cash balance; σ^2 is the variance of daily cash-balance changes; and R is the investment interest rate.

Orgler Model

The optimal cash level according to the Orgler Model is calculated using the following linear-equation approach:

- Maximum Profit = (Available Cash – Minimum Cash) × Investment Return
- Available Cash = Cash Balance + Cash Inflows – Cash Outflows
- Investment Amount ≤ Available Cash
- Available Cash ≥ Maturing Liabilities
- Available Cash ≥ Long-Term Investment Installments (If Applicable)

Stone Model

The optimal cash level under the Stone Model is calculated using the Miller–Orr approach, but incorporates projected future cash flows.

RESULTS AND DISCUSSION

Cash Flow Analysis of Pertagas

The evaluation of Pertagas' 2024 cash flows reveals significant volatility across operating, investing, and financing activities. Operating cash flows fluctuated substantially throughout the year, with the lowest point in February due to a -45.7% month-on-month decline in Transportation Revenue, and the highest in August driven by a one-time Marketing Fee inflow of approximately USD 28 million. Although volatile, the overall trend indicates a gradual upward movement, suggesting strengthening operating performance despite variable monthly inflows.

Investment cash flows also exhibited large fluctuations. A major positive spike occurred in May, reaching approximately USD 25 million due to dividend receipts; however, the general trend was negative, reflecting increasing investment outflows over time. The sharp decline in December implies sizeable capital expenditures, likely related to asset acquisitions or infrastructure expansion.

In terms of financing cash flows, Pertagas did not receive any external funding throughout 2024. Financing activities were limited to loan repayment in February and dividend distribution in May. This reliance on internal cash generation highlights strong operating capacity but also exposes the company to liquidity risk if operational or investment cash flows weaken. While dividend payments demonstrate commitment to shareholders, they also reduce the cash buffer available for reinvestment.

Overall net cash flow reflected combined volatility from the three components, with the sharpest decline occurring in May (approximately USD –175 million) due to dividend payouts. Recovery in the following months pushed net cash back into positive territory, signaling effective internal cash management. However, the severe drawdown in May underscores the company's vulnerability to liquidity pressures under unexpected demands. To mitigate such risks, Pertagas would benefit from establishing strategic cash reserves, maintaining short-term liquidity facilities, adjusting capital expenditure schedules, and optimizing working capital to accelerate receivables. These measures are essential to sustaining operations and meeting shareholder obligations without compromising financial stability.

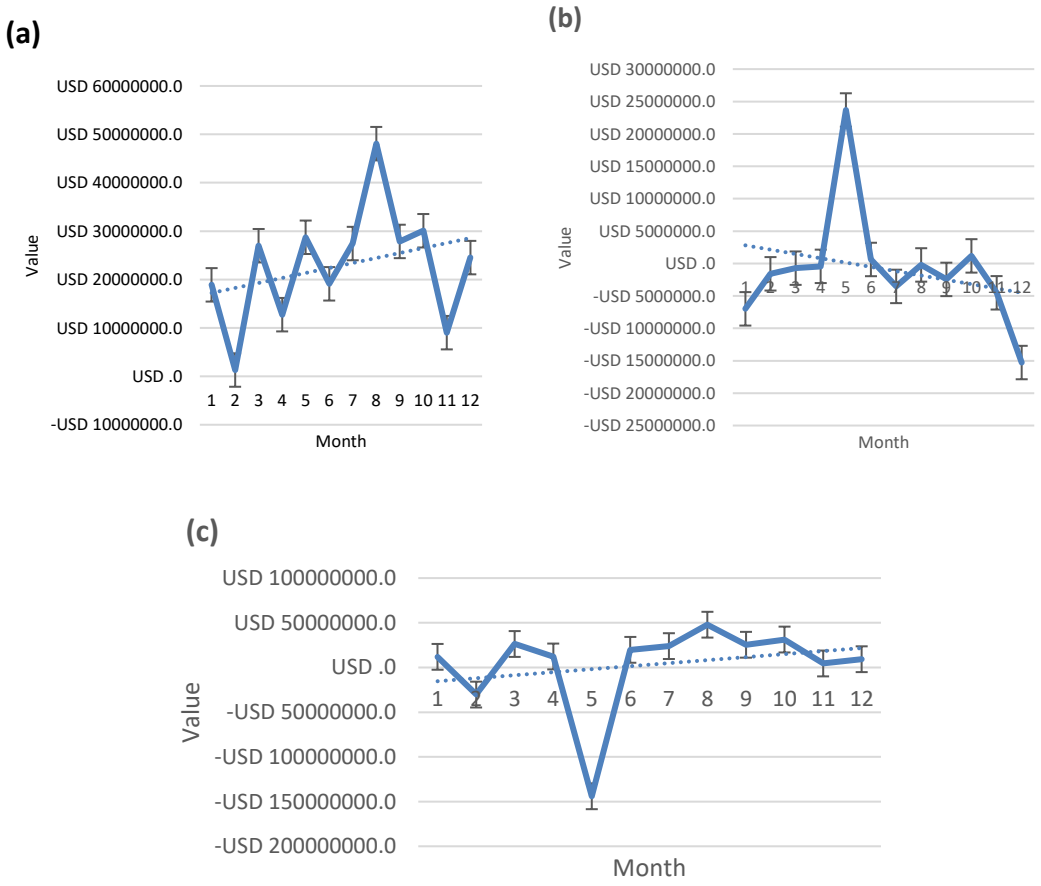

Figure 1. Cash Flow Conditions of Pertagas 2024. (a) Operating Cash Flow. (b) Investing Cash Flow. (c) Net Cash Flow.

The Value-at-Risk (VaR) analysis of Pertagas' net cash flows indicates that at the 95% confidence level, the company faces a potential cash flow loss of up to –USD 81,484,320 under extreme market conditions. This potential loss exceeds the company's average monthly net cash flow of USD 3,174,586, highlighting the substantial volatility and financial risk Pertagas must manage. With a standard deviation of USD 50,013,446 and a minimum recorded net cash flow of –USD

144,059,770, the company is exposed to large fluctuations that could threaten liquidity and operational continuity. These findings underscore the urgency of implementing structured and strategic cash management practices, particularly in determining an adequate minimum cash balance. Adaptive, risk-responsive cash management is essential for strengthening financial resilience and supporting Pertagas' business sustainability amid the inherent uncertainty of the energy industry.

Table 1. Historical (Non-Parametric) Value at Risk (VaR)

Confidence Level	5%
Confidence Interval	95%
VaR	**-USD 81,484,320**
Mean	USD 3,174,586
STDEV	USD 50,013,446
Min	-USD 144,059,770
Max	USD 47,864,499
VaR Relative to Mean	**-USD 84,658,906**

Baumol Cash Management Model

In this equation, *i* represents the deposit interest rate or opportunity cost, which is 6.25% for IDR in 2024; *T* denotes the total annual cash requirement, estimated using three different approaches; and *b* refers to the annual transaction cost, derived from the accumulated expenses associated with transfers, withdrawals, fund movements, and administrative fees. The model assumes that the company's cash usage rate is constant, transaction costs do not depend on the amount of cash involved, and the opportunity cost of holding cash is reflected in an interest rate that does not vary with the cash balance. The calculation is summarized in the following table.

Table 2. Results of Baumol Model (USD)

Description	(i) Working Capital	(ii) Cash Outflow	(iii) Cost of Goods	(iv) Average
Annual Cash Requirement	70,437,690	236,732,242	306,757,771	204,642,568
Transaction Cost	IDR 155,000 + (0.5% Annual Cash Requirement / 12 mos / 2 trx) ≈ USD 10 + (0.5% Annual Cash Requirement / 12 mos / 2 trx)			
Securities Interest Rate				6.25%
Optimal Cash Level (Annual)	5,753,173	19,331,066	25,048,627	16,710,955
Optimal Cash Level (Daily)	363,137	1,220,166	1,581,055	1,054,786

According to the data in Table 2, the optimal cash level for Pertagas based on the Baumol approach should be maintained at USD 16,710,955 for a one-year period. When converted into a daily figure, the company's cash balance should be kept at no less than USD 1,054,786.

Beranek Cash Management Model

The optimal cash level under the Beranek model is, where *a* represents transaction costs amounting to USD 42,644, *Y* denotes the total cash requirement of USD 236,732,242, *i* is the opportunity cost set at 6.25% for 2024, and *n* indicates the optimal number of transactions. This model operates under several key assumptions: the company is able

to accurately predict its cash needs, cash inflows occur consistently within a given period, and cash outflows are executed instantaneously but in a planned manner. Furthermore, both the opportunity cost of holding cash and transaction costs are assumed to be known and constant throughout the period of analysis.

$$n = \sqrt{\frac{0.0625 * 236{,}732{,}242}{2 * 42{,}644}}$$
$$n = 13{,}17 \approx 13\ Transaction$$

$$Profit = \left(\frac{(n-1)}{2n}\right) iY - na$$
$$Profit = \left(\frac{(13-1)}{2 * 13}\right) 0.0625 * 236{,}732{,}242 - 13 * 42{,}644$$
$$Profit = USD\ 6{,}274{,}443$$

$$Final\ Withdrawal = \frac{n-1}{n} Y$$
$$Final\ Withdrawal = \frac{13-1}{13} * 236{,}732{,}242 = USD\ 218{,}522{,}070$$

$$Periodic\ Investment = \frac{1}{n} Y$$
$$Periodic\ Investment = \frac{1}{13} * 236{,}732{,}242 = USD\ 18{,}210{,}173$$
$$Daily\ Periodic\ Investment = \frac{USD\ 18{,}210{,}173}{SQRT(251)} = USD\ 1{,}149{,}416$$

Based on the data above, it can be concluded that the company is advised to allocate USD 18,210,173 periodically as reserve funds (cash balance) outside of its main cash holdings. In a daily context, the amount of cash that needs to be withdrawn or allocated is at the level of USD 1,149,416.

Miller-Orr Cash Management Model

The Miller–Orr model relies on several key assumptions: (a) cash inflows and outflows are stochastic, meaning they are not constant and may fluctuate over time; (b) daily cash balances follow a normal distribution and therefore occur randomly; and (c) the firm maintains a minimum acceptable cash balance, referred to as the lower limit. Based on these assumptions, the calculation for annual cash proceeds as follows:

$$C = 19{,}457{,}824 + \left(\frac{3}{4}\ x\ 42{,}644\ x\ \frac{11{,}372{,}228{,}393{,}784{,}900}{0{,}0625}\right)^{1/3}$$
$$C = 37{,}444{,}942$$

$$U = 3C - 2L$$
$$U = 3(37{,}444{,}942) - 2(19{,}457{,}824)$$
$$U = USD\ 73{,}419{,}178$$

While the equation for daily cash will be as follows:

$$C = 4{,}239{,}432 + \left(\frac{3}{4}\ x\ 2{,}692\ x\ \frac{156{,}327{,}598{,}200{,}894}{0{,}0625/251}\right)^{1/3}$$
$$C = 4{,}511{,}414$$

$$U = 3C - 2L$$
$$U = 3(4{,}511{,}414) - 2(4{,}239{,}432)$$
$$U = USD\ 5{,}055{,}377$$

Table 3. Miller-Orr Calculation Results (Annual and Daily)

Cash Level	Annual Value (USD)	Daily Value (USD)
Upper Limit	73,419,178	5,055,377
Optimal Level	37,444,942	4,511,414
Lower Limit	19,457,824	4,239,432

Stone Cash Management Model

The optimal cash level under the Stone model is calculated using the Miller–Orr framework, but incorporates projected future cash flows. The optimal cash level is determined using the following formula:

$$C = 18{,}304{,}957 + \left(\frac{3}{4}\ x\ 42{,}644\ x\ \frac{5{,}611{,}758{,}024{,}366{,}120}{0{,}06}\right)^{1/3}$$
$$C = 32{,}713{,}574$$

$$U = 3C - 2L$$
$$U = 3(32{,}713{,}574) - 2(18{,}304{,}957)$$
$$U = USD\ 61{,}530{,}807$$

While the equation for daily cash will be as follows:

$$C = 3{,}987{,}855 + \left(\frac{3}{4}\ x\ 2{,}692\ x\ \frac{77{,}141{,}666{,}809{,}401}{0{,}06/251}\right)^{1/3}$$
$$C = 4{,}205{,}727$$

$$U = 3C - 2L$$
$$U = 3(4{,}205{,}727) - 2(3{,}987{,}855)$$
$$U = USD\ 4{,}641{,}469$$

Table 4. Stone Model Calculation Results (Annual and Daily)

Cash Level	Annual Value (USD)	Daily Value (USD)
Upper Limit	61,530,807	4,641,469
Optimal Level	32,713,574	4,205,727
Lower Limit	18,304,957	3,987,855

Orgler Cash Management Model

Based on the Orgler cash management model, Pertagas can optimally allocate its cash after meeting debt obligations and investment installment payments, thereby generating the potential for maximum cash investment returns of USD 10,898,192 in 2024 and USD 7,038,681 in 2025.

Table 5. Orgler Model Analysis Results for Pertagas (Realized 2024 and Forecast 2025)

Item	2024 (USD)	2025 (USD)
Cash Balance	395,396,108	211,795,281
Cash Inflows	274,827,273	265,682,994
Cash Outflows	236,732,242	186,024,506
Available Cash	433,491,139	291,453,770
Minimum Cash (Lower Limit)	19,457,824 (Miller–Orr)	18,304,957 (Stone)
Investment Return Rate	6.25%	6.00%
Maturing Debt	239,662,250	155,837,456
Optimal Investment Amount	174,371,065	117,311,356
Maximum Potential Profit	10,898,192	7,038,681

Discussion

Cash management plays a vital role in maintaining the stability and operational sustainability of Pertagas, particularly as an energy company engaged in large-scale and long-term infrastructure projects. In this context, cash management—which includes the ability to maintain adequate liquidity, minimize the cost of idle funds, and anticipate sudden cash requirements—becomes a determining factor for financial efficiency and the company's resilience to external shocks (Hessian, 2024). The Value at Risk (VaR) analysis of Pertagas' net cash flow reinforces this urgency, indicating a potential monthly cash loss of USD 81,484,320 at the 95% confidence level. This figure is significantly higher than the company's average monthly net cash of USD 3,174,586, signaling high cash-flow volatility that must be managed. Such uncertainty may stem from fluctuations in global energy prices, currency exchange rates, and changes in government policies. Therefore, data-driven and risk-based cash-management approaches are highly relevant to ensure that the company remains liquid and operational across various economic conditions.

The Baumol Model represents a classical approach that adapts the Economic Order Quantity (EOQ) principle to cash management. This model assumes that cash expenditures occur at a steady and predictable rate, and that the company does not face significant uncertainty in daily cash flows. Accordingly, the model determines the optimal amount of cash a firm should hold to minimize the total cost consisting of transaction costs (cash withdrawals) and opportunity costs. Although the mathematical formulation is simple, this model remains relevant for firms that operate in financially stable environments. In the case of Pertagas, implementing the Baumol Model indicates that an annual optimal cash level of USD 16,710,955 provides an efficient balance between withdrawal costs and the interest lost from idle cash. This model is well suited for businesses with relatively stable cash flows, such as when revenues and expenses can be planned on a monthly basis. While it is not flexible under uncertainty or

variability, its advantage lies in its ease of calculation and effectiveness under routine and predictable operating conditions.

The Beranek Model was developed as an enhancement of the Baumol Model, retaining its deterministic nature while adding emphasis on the optimal number of transactions and the volume of cash withdrawals. This model enables financial managers not only to determine the optimal cash balance but also to design a more structured withdrawal cycle based on periodic funding needs. Thus, the Beranek Model offers greater flexibility when the number of cash transactions is relatively high but remains predictable. In the Pertagas case study, the Beranek Model produced an estimate of 13 cash-withdrawal transactions per year, with a periodic cash-withdrawal value of USD 18,210,173. Compared to the Baumol Model, this approach is more operationally useful in managing the volume and timing of cash drawdowns, supporting more realistic and efficient cash-planning practices in environments with routine transaction burdens. Although it still does not consider uncertainty, this model is preferred when companies desire periodic control over cash cycles with a fixed withdrawal structure. In conclusion, both models are appropriate when a company's cash flows are planned, stable, and predictable, such as when the firm faces minimal external uncertainty or routine financial cycles without major project impacts or market disruptions.

The Miller–Orr Model adopts a stochastic approach and is designed for firms facing uncertainty in cash inflows and outflows. Unlike the deterministic Baumol and Beranek models, Miller–Orr introduces the concepts of a lower limit, an upper limit, and a return point for cash balances. When the cash balance hits either limit, the firm takes action to revert the balance to the return point. This approach acknowledges the real-world unpredictability of corporate cash flows. In the analysis of Pertagas' financial conditions, the Miller–Orr Model indicates an optimal cash level of USD 37,444,942 with an upper limit of USD 73,419,178. This suggests that the company has greater room to absorb cash-flow fluctuations before corrective action is required. The model is particularly suitable for companies like Pertagas that may experience sudden changes in project needs, operational costs, or impacts from global economic conditions. Accordingly, the Miller–Orr Model offers high flexibility in the face of uncertainty and is highly relevant for large enterprises that do not experience uniform cash-flow cycles.

The Stone Model is a further modification of the Miller–Orr Model, introducing cash-flow forecasting into the cash-decision framework. Rather than relying solely on upper and lower limits, this model assesses whether projected cash flows indicate future surpluses or deficits. Thus, decisions to replenish or withdraw cash depend not only on current cash positions but also on short-term projections, making the model more adaptive to dynamic financial conditions. In the Pertagas case study, the Stone Model produced an optimal cash level of USD 32,713,574 with an upper limit of USD 61,530,807, using a 6% interest parameter and adjusted daily cash-flow variance. The strength of this model lies in its ability to adjust cash-policy decisions based on actual forecasts, which is critical in the digital era and in data-driven decision-making environments. Therefore, the Stone Model is ideal for large companies implementing ERP systems and modern forecasting tools to anticipate cash requirements more precisely. It is the most advanced among the four cash-management approaches in handling uncertainty and market dynamics. As a result, both the Miller–Orr and Stone models are suitable for firms with fluctuating cash flows, such as state-owned enterprises with multiple new projects, regional expansions, or exposure to shifts in

global economic policy. Due to the uncertainty they address, the minimum cash levels required under these models are higher than those derived from the Baumol and Beranek Models.

For comparison, additional analysis also shows Pertagas' optimal daily cash levels, as summarized in Table 6. These optimal daily cash values are lower than Pertagas' current practice of maintaining a daily cash buffer of IDR 200 billion. This discrepancy indicates the presence of an opportunity cost incurred by maintaining cash levels significantly above the optimal requirement.

Table 6. Summary of Optimal Cash Levels Across Cash-Management Models

Model	Assumption Basis	Output Type	Optimal Cash / Investment Value (USD)	Notes
Baumol Model	Deterministic, stable cash flows	Optimal cash balance	16,710,955	Reflects balance between transaction cost and opportunity cost.
Beranek Model	Trade-off between opportunity cost and liquidity risk	Optimal cash balance	18,210,173	Higher due to volatility and shortage-risk considerations.
Miller–Orr Model	Stochastic cash flow variability	Minimum cash limit	19,457,824	Accounts for unpredictable fluctuations; sets lower bound for liquidity.
Stone Model	Stochastic + short-term cash flow forecasts	Minimum cash limit	32,713,574	Higher threshold due to forward-looking projections for 2025.
Orgler Model	Integrated cash + working-capital optimization	Investable cash	174,371,065	Maximum potential investment return: USD 10,898,192.
Orgler Model	Integrated cash + working-capital optimization	Investable cash	117,311,356	Maximum potential investment return: USD 7,038,681.

The Orgler cash-management model offers a more realistic and integrated approach compared to the preceding models, as it considers the actual operational constraints faced by companies. In this model, cash-investment decisions are made by maximizing returns from available cash after deducting minimum cash requirements, maturing liabilities, and long-term investment installments. Using linear programming, Orgler enables companies to determine the optimal short-term investment allocation based on actual cash needs and available returns. This method is particularly appropriate for firms with complex cash-flow structures and simultaneous short- and long-term obligations. The Orgler Model analysis of Pertagas' 2024 and 2025 financial statements shows substantial available cash that can be optimized after covering operational and financial obligations. In 2024, total available cash reached USD 433 million, with an optimal investment allocation of USD 174 million and a maximum potential return of USD 10.89 million. In 2025, despite having a lower opening cash balance, Pertagas could still allocate USD 117 million for cash investments with a maximum potential return of USD 7.04 million. These findings demonstrate that the Orgler Model effectively identifies opportunities to enhance returns from excess corporate cash, provided that investment decisions are aligned with actual cash flows and short-term obligations.

MANAGERIAL IMPLICATION

The findings of this study highlight several strategic implications for Pertagas in strengthening its cash-management practices. First, Pertagas should adopt the assumption that cash inflows are inherently volatile, given the company's exposure to global energy-price fluctuations, foreign-exchange dynamics, and changes in industrial demand. Recognizing this volatility will allow the company to utilize more flexible cash-management frameworks such as the Miller–Orr or Stone models, which are designed to respond adaptively to stochastic cash-flow patterns. This assumption, however, requires the incorporation of additional variables and the application of multiple scenarios in forecasting processes, leading to a wider range of estimated cash-balance requirements and the potential for both understatement and overstatement in liquidity planning.

Furthermore, Pertagas would benefit from integrating quantitative models into its cash-management system by combining the Miller–Orr, Stone, and Orgler approaches to align cash-balance decisions with real-time transactions, short-term forecasts, and investment opportunities. Implementing automated daily cash-balance monitoring systems would further support this approach by enabling faster detection of threshold breaches and more timely adjustments in transfers or short-term investments. Strengthening cash-flow planning and forecasting accuracy is also essential, as more reliable projections enhance the effectiveness of models such as Beranek and Orgler in determining minimum cash levels, investment allocation, and short-term financing requirements.

In addition, Pertagas should consider diversifying its investments of idle cash into low-risk short-term instruments, consistent with the optimization results from the Orgler model. This strategy would ensure that unused funds generate financial returns rather than remaining passively idle. The company should also revisit its internal minimum cash-balance policy to ensure better alignment with actual volatility and operational needs, thereby minimizing the likelihood of excess liquidity or shortages that could disrupt operations. Finally, periodic evaluation of cash-management performance is necessary to allow for timely adjustments to key parameters—such as investment yields, cash-flow variability, and minimum liquidity thresholds—ensuring that cash-management policies remain relevant and adaptive to evolving business and economic conditions.

CONCLUSION

This study demonstrates that Pertagas' current cash-management practices rely predominantly on historical trends and have not yet fully adopted structured quantitative approaches. As a result, explicit considerations of cash-flow volatility, transaction costs, and short-term investment opportunities are not systematically incorporated into decision-making. The application of five established cash-management models provides a comprehensive assessment of optimal cash levels under varying conditions. The Baumol and Beranek models yield optimal cash balances of USD 16.71 million and USD 18.21 million, respectively, under relatively stable cash-flow assumptions. In contrast, the Miller–Orr and Stone models offer more adaptive mechanisms for uncertainty, producing minimum cash thresholds of USD 19.46 million for 2024 and USD 32.71 million for 2025 under forecast-based projections. The Orgler model further demonstrates the potential for integrated optimization, indicating that Pertagas could allocate USD 174.37 million (2024) and USD 117.31 million (2025) for

short-term investments, generating estimated maximum returns of USD 10.90 million and USD 7.04 million. Collectively, these results indicate that a combined application of stochastic control models (Miller–Orr or Stone) and linear-programming approaches (Orgler) would enhance Pertagas' liquidity efficiency and strengthen financial resilience amid ongoing global uncertainty.

Future research and corporate practice should explore a deeper integration of cash-management frameworks with Pertagas' capital-investment planning, particularly for large-scale energy infrastructure projects where liquidity planning and capital budgeting are interdependent. Scenario-based simulations, including stress testing under extreme energy-price shocks or currency volatility, are recommended to evaluate the robustness of cash-management policies under high-risk conditions. Additionally, further studies may assess the adoption of digital technologies—such as machine learning–based forecasting or AI-driven financial analytics—to improve the accuracy of cash-flow predictions and support more responsive, data-driven liquidity planning. Incorporating these enhancements would allow Pertagas to refine its cash-management strategy, optimize investment decisions, and maintain operational continuity in an increasingly volatile financial environment.

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