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Impact of working capital management on firm's profitability:

An empirical study on Vietnamese listed firms

Bachelor Thesis

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List of abbreviations

APDAY	Accounts payable days
ARDAY	Accounts receivable days
CCC	Cash conversion cycle
EOQ	Economic order quantity
EVA	Economic value added
FEM	Fixed effect model
FSIZE	Firm's size
GDP	Gross domestic product
GPM	Gross profit margin
INTDAY	Inventory days
JIT	Just-in-time
LEV	Firm's leverage
REM	Random effect model
ROA	Return on asset
ROE	Return on equity
VIF	Variance inflation factor



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Abstract

Working capital is a major source of finance to firms, and proficient management of working capital would significantly contribute to the sustainable development of the companies. This study focuses on examining the relationship between working capital management, as assessed by working capital efficiency, and the profitability of Vietnamese firms. Using a sample of 604 companies listed on the Vietnamese Stock Market from 2001 to 2019, with quantitative research methodologies such as fixed effect and random effect regression on panel data, the research provides empirical evidence for the following noticeable results. The components of working capital efficiency including accounts receivable days, inventory days, accounts payable days and cash conversion cycle, are proven to have statistically significant and negative relationships toward the firms' profitability measured by gross profit margin. Furthermore, based on the findings, the study also gives advice to the financial managers of Vietnamese firms on applying the appropriate working capital policies to maintain profitability as well as to avoid insolvency. That is firms should employ the moderate strategy when investing and financing working capital.



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1. Introduction

Financial management is crucially important and necessary to corporations in administration and operating businesses as it gives firms competitive advantages in the market. The financial management process involves managing financial resources and making financial decisions such as financing, investment, dividend decisions as well as risk mitigation (BPP Learning Media, 2019). One of the essential aspects of financial management which will be critically discussed in this paper is working capital management. Over the world, financial researchers have found it fascinating to explore topics related to working capital. There have been various empirical studies conducted to investigate the effects of working capital on businesses. Most researchers focus on the relationship between working capital and liquidity as well as profitability of the firms. Some of them specifically concentrate on analyzing the impact of working capital policies and strategies on the firms' performance. Boisjoly, Conine, & McDonald (2020) investigate the impact of ongoing improvement programs and aggressive working capital policy on working capital efficiency over a 27-year period from 1990 to 2017. Adopting a data set of Finnish listed firms for the period of 18 years, Enqvist, Graham, & Nikkinen (2014) study the influence of business cycles on the working capital-profitability relationship.

The objective of this paper is to deploy an empirical research on investigation of the effects of working capital management on profitability of Vietnamese listed firms for the period of 19 years using quantitative method. The data set is collected from the financial statements of 604 public companies listed on the Vietnamese Stock Exchange from 2001 to 2019. This paper consists of four main parts. The first part is the theoretical background, which give an overview of basic knowledge of working capital and working capital management such as concepts, management techniques and policies. Then the second part is about reviewing past literatures of similar topics to have a comprehensive view on the research methodologies and results for reference. In addition, the third part will discuss about the main research approach applying descriptive statistic, Pearson correlation analysis, multiple regression models and testing for multicollinearity as well as autocorrelation. And finally, the fourth part will present the empirical results of the study and critically discuss the findings as well as give recommendations and practical application.

2. Theoretical background

2.1. Composition of working capital and its characteristics

Working capital, which consists of current assets and current liabilities, is usually known as the required capital that firms use and control to operate business and make short-term financial decision (Berk & DeMarzo, 2017). “Short-term” here refers to the period of time of 12 months or less. The difference between current assets and current liabilities is defined as net working capital (Berk & DeMarzo, 2017). Current assets commonly comprise cash, amounts receivable from customers, inventory and sometimes marketable securities. Current liabilities usually include bank overdraft, short-term loans and amounts payable to suppliers. They are short-term funds to finance the current assets (Shapiro & Moles, 2014).

The working capital characteristics are different across different types of business (BPP Learning Media, 2019). There are usually 3 aspects that accounted for these differences: holding inventory (from the procurement of materials or goods, through the manufacturing and storing process, to the time of selling products), time to settle payments with vendors or creditors, and time to collect amounts receivable from customers (BPP Learning Media, 2019). When controlling the working capital, the size of investment in accounts receivables or accounts payables and stocks could not be randomly picked, but it would be determined mostly by the nature of the business and the industry in which the firm operates (Brealey, Myers, & Allen, 2020). To see how the characteristics rely on the nature of the business, taking an illustration in retail industry and manufacturing industry. For retail companies, such as supermarkets, would not require much working capital as their payment mechanism is liquid. They collect sales revenue in cash and they often make payment to their suppliers on credit. Therefore, they would have an advantage in cash holdings and would not need to invest heavily in working capital. In contrast, manufacturing firms or construction firms need to invest significantly in working capital because the nature of their payment mechanism is often long-term. Their sales are mostly on credit and thus they need to use more short-term loans to cover their current obligations in order not to fall into distress.

2.2. Objective of working capital management

Working capital management involves overseeing all aspects of both current assets and current liabilities so as to mitigate the risk of insolvency while optimizing firm’s profit (Kaplan Publishing,

2020). The objective of managing working capital has two primary aspects. It includes guaranteeing that the company has enough liquid resource to sustain business operation, and enhancing the firm's earning (BPP Learning Media, 2019). Having liquidity to continue business operation means that the company be able to meet its payment obligations when it is time to settle using assets that could be easily converted into cash (Clayman, Fridson, & Troughton, 2012). Every business requires enough cash on hand to maintain daily cash flow such as employee's wages or supplier payments. Liquidity can be preserved by avoiding excess funds tied up in inventory and accounts receivable, reducing the risk of facing liquidity problems (BPP Learning Media, 2019). However, if a firm operates its business with excessively low working capital levels, that is low amount of investment in inventory and receivables, then this could possibly lead to trading problems and lower profits. For example, low inventory levels indicate that firms do not have enough inventory to meet peaks in customer demands, leading to excessively high delivery lead times to customers, causing lost sales. The same scenario happens in receivables management. Low amounts receivable means that the firm's credit term policy is strict, and the customers cannot enjoy long credit period, this may lead to lost sales in some industries, especially in manufacturing industry because manufacturing companies are not always having good liquidity to settle payments. The mentioned examples imply that the objectives of working capital management, liquidity and profitability, may sometimes conflict with each other. That is having high liquidity causing low profitability and vice versa. Nevertheless, their conflict does not always happen. For instance, if amounts of inventory and receivables are high due to poor working capital management, then the improved management of warehousing system (to keep low inventory level) and credit control (to keep low receivables level), can result in both higher liquidity and profitability (BPP Learning Media, 2019). And thus, the overall objective of working capital management is to balance between liquidity and profitability, depending on the company's orientation.

2.3. Working capital management methods

Working capital management is one of the most important factors to keep a firm on track on its way to success. Improving working capital management plays a key role in operating a business, helping companies to avoid insolvency and stabilizing the development of businesses. There are various methods to control working capital efficiently and the four most common are cash management, inventory management, receivables management and payables management.

2.3.1. Inventory control

For many businesses, inventory is a considerable investment and represents one of the necessary elements of production. Firms need inventory to function for a variety of reasons. Firstly, it helps firms to reduce the risk of not having enough inputs required for production (Berk & DeMarzo, 2017). When a company runs out of stock, its revenue may decrease as the firm cannot satisfy the customers' demand, and thus the disappointed customers might switch to one of the firm's competitors (Berk & DeMarzo, 2017). Furthermore, factors such as seasonality in demand – mean that customer purchases do not exactly align with the most efficient production cycle, allowing firms to hold inventory (Berk & DeMarzo, 2017). However, holding inventory can incur the following cost: cost related to high inventory levels and cost related to low inventory levels. For the cost related to high inventory levels, first thing to mention is the purchase cost. Purchase cost represents an opportunity cost of holding inventory, incurs when the goods are purchased, firms' capital is tied up in them. And up until the goods being sold on, such capital earns no return (Kaplan Publishing, 2020). The second thing is the storage and stores administration cost. That expense incurs when the company rent out for repository, or if the firms have their own warehouse to use, there is an opportunity cost associated with the alternative use of such space (Kaplan Publishing, 2020). There are also other costs such as insurance expenses, wages for staffs to manage and protect the warehouse against theft, investment for advanced inventory control systems when inventory levels are high and so on (Kaplan Publishing, 2020). The longer the inventory is kept, the more likely it will be spoiled and obsolete. That can be seen in case of perishable goods, fashion items, technological products (Kaplan Publishing, 2020). But keeping inventory too low can put the company in trouble as their business would face alternative problems: stock-out, high re-order/setup cost and lost quantity discount (Kaplan Publishing, 2020). When a firm's certain supplies used in manufacturing dries up, it can create disruptions in the production process, and thus result in idle time, excessive accumulation of work-in-process (WIP), missed orders (Kaplan Publishing, 2020). This leads to dissatisfaction among customers because the firm's inventory on hand would not meet the demand and it even possibly leads to future lost orders if the customers switch to other suppliers. Next thing to mention is high re-order/setup cost. When inventory runs out, new supplies need to be acquired, incurring the cost associated with administration and setting up the machinery each time a new batch is produced. Bulk discounts from suppliers are usually

attractive to corporations when ordering supplies and they are not available if firms only buy small quantities at a time to keep inventory low. Therefore, the purpose of efficient inventory management is to “reduce inventory to the lowest possible amount to minimize the level of capital employed to be funded, while guaranteeing that enough stock amount is held so that it would not dry up and cause interruptions to the business operations” (Kaplan Publishing, 2020).

There are several techniques in managing inventory. One of them can be mentioned is using economic order quantity model (EOQ). It is the most well-known method for explicitly determining an ideal inventory level when ordering from suppliers (Ross, Westerfield, & Jaffe, 2013). The economic order quantity is the optimal order quantity for an inventory item that will diminish inventory related costs such as holding costs, ordering costs and purchasing costs (BPP Learning Media, 2019). The formula calculating EOQ is written as:

$$EOQ = \sqrt{\frac{2S \times O}{C}}$$

where S is the firm's total unit sales per year, O is the ordering cost per order and C is the carrying cost per unit per year (Block, Hirt, & Danielsen, 2017). The EOQ is the most cost-effective quantity for the company to order each time. Another common technique is applying just-in-time (JIT) system. Just-in-time (JIT) system is a set of manufacturing and supply chain techniques that attempt to reduce inventory level and enhance customer service by not only producing exactly when customers demand, but also producing the precise quantities they need at competitive prices. JIT aims to smooth out the flow of work through the manufacturing plant, create a flexible and responsive production process and decrease the capital tied up in inventory (Kaplan Publishing, 2020). JIT has two aspects relating to procurement process and production process. A practice known as just-in-time procurement is acquiring products from suppliers as soon as possible (that is when they are required), which eliminates the need to keep any inventory of raw materials or component parts (BPP Learning Media, 2019). Just-in-time production is a term which refers to manufacturing on order demand. Manufacturing is initiated to fulfil new orders as they are received. This makes it possible to better customize products, eliminate the risk of obsolescence and reduce holding costs (BPP Learning Media, 2019). JIT enables a business to maintain buffer inventory to compensate for ineffective procedures. Just-in-time inventory management is efficient

when the production flow is consistent and predictable, and would not be appropriate if the production process and suppliers are unreliable.

2.3.2. Receivables control

Most businesses settle their payments on credit, leading to the existence of accounts receivable on the balance sheet of the companies. The larger the amounts receivable, the more costly for firms, both in terms of interest expense on taking overdraft to finance for the credit term, and in terms of greater risk of irrecoverable debt. Accounts receivable management is to balance the trade-off between two aspects: swiftly collecting sales receipts to decrease the cost of financing the receivables balance, and stretching the credit term to the customers to help them settle payments easier, generates more sales for the company. In order to manage receivables well, the company needs to adopt a suitable credit policy when granting credit to customers. According to Berk & DeMarzo (2017), setting up a fine credit policy involve three steps: “establishing credit standards, establishing credit terms and establishing a collection policy” (Berk & DeMarzo, 2017). So as to formulate credit standards, management must first evaluate the creditworthiness of customers, by investigating whether the financial situation of new customers is reliable enough to settle payments, while periodically reviewing that of current customers, particularly if they ask to have their credit limit increased. There are several sources for a company to acquire information about their customers’ credit rating, including: bank references, trade references, published information such as customers’ annual accounts and reports, customers’ sales records and credit scoring. The amounts of funds a company decide to invest on its receivables is largely influenced by the decisions of how much credit risk to take on (Berk & DeMarzo, 2017). Following the establishment of credit standards, credit terms must be set up. The credit terms should reflect the length of the period before payments settlement and the discount percentage as well as the discount period. If the company is modest compared to others in the industry, it will probably follow their lead in defining these terms (Berk & DeMarzo, 2017). The final step is to develop a collection policy. Monitoring receivables for problems and recovering payment on past-due accounts as well as collection efforts such as reminder letter sending, telephone call, legal action taking, are part of the collection policy. Monitoring accounts receivables involve two tools, which are accounts receivable days and the aging schedule (Berk & DeMarzo, 2017). The average number of days it takes a business to collect on its sales is known as the accounts receivable days. To assess the

efficacy of its credit policy, a company might compare this figure to the payment policy outlined in its credit terms (Berk & DeMarzo, 2017). The aging schedule is a crucial report that receivables managers should use (Clayman, Fridson, & Troughton, 2012). With this second basic tool, accounts are categorized according to how long they have been on the company's book. The procedure is as follows: firstly, sort receivables by age, such as in groups based on the number of unpaid months; then total the sorted group and finally the total should be multiplied by a factor that reflects the likelihood of payment based on prior experience (Sagner, 2014). The company will probably need to review its credit policy when they realize there exists so much overdue debt and the allowance amount for doubtful debt is too large.

2.3.3. Payables control

Accounts payable, also referred to as trade credit, are formed when companies make credit-based purchases of products and services. It is the largest operating current obligation and it accounts for around 40 percent of the current liabilities of the typical non-financial firms (Ehrhardt & Brigham, 2011). For many businesses, trade credit is the most straightforward, crucial form of short-term financing and should be used only if it is the cheapest source of funding. Efficient administration of trade payables requires negotiating satisfactory credit terms from suppliers, getting credit extended during periods of cash scarcity and keeping excellent relations with vendors (BPP Learning Media, 2019). Managing accounts payables aims to postpone payments settlement with suppliers to enjoy a free source of funding, but it must be done with caution to prevent generating problems for the business in the long run. The problems could possibly involve: reputational harm, vendors charging higher prices in future, and suppliers even deny supplying the next time company orders. The loss of goodwill from vendors and any attainable settlement discounts for early debt settlement are two costs associated with making the most of trade credit (BPP Learning Media, 2019). By comparing the savings from the discount with the opportunity cost of investing the cash used, it is possible to determine the cost of lost cash discounts (BPP Learning Media, 2019). The cost of lost cash discounts could be estimated by the formula as follow:

$$\left\{ \left[\left(\frac{100}{100 - d} \right)^{\frac{365}{t}} \right] - 1 \right\} \%$$

where d is the discount rate in percent, t is the number of days that must be cut from the payment period in order to qualify for the early payment discount; the deadline for applying the discount is also the deadline for making the payment (BPP Learning Media, 2019). A business should keep track of its accounts payable, much like it should with its accounts receivable, to guarantee that payments are settled on time. Calculating the days of accounts payable outstanding and comparing them to the credit terms is also an effective approach (Berk & DeMarzo, 2017). Depending on the connection between a company and its vendors, it is possible to extend payments past the stipulated periods (Foerster, 2015). To rephrase it, a supplier may be willing to turn a blind eye on a company that is a touch delayed in debt settlement as long as it can retain that business as a customer (Foerster, 2015). This is especially true in highly competitive supply businesses (Foerster, 2015).

2.3.4. Cash control

A cash flow is like a bloodstream of the firm, directly reflecting the financial health of the organization. There are a variety of purposes to keep cash on hand, but the three most obvious motives are: transaction motive, precautionary motive and speculative motive (also called investment motive) (Kaplan Publishing, 2020). Firms need an adequate cash reserve to maintain a certain level of liquidity in order to pay for forecasted day-to-day corporate expenses. These expenses could include: purchases, employee's wages and salaries, current taxes, annual dividends to shareholders, due debt to creditors, overheads which incur in the normal course of business. The mentioned aspect reflects the transaction motive of holding cash. A transaction balance could be used to refer to the amount of money a business needs to be able to pay its invoices (Berk & DeMarzo, 2017). The second purpose to maintain cash on hand is to serve precautionary motive. The necessity for a safety supply (buffer) to serve as a financial reserve for unforeseen contingencies is the precautionary motive (Ross, Westerfield, & Jaffe, 2013). This buffer could be given through an overdraft facility, which has the benefit of being free until it is spent (BPP Learning Media, 2019). The amount of cash held by a company to offset the uncertainty around its future cash needs is called precautionary balance (Berk & DeMarzo, 2017). The size of this balance is determined by how uncertain a firm's cash flows are. The harder it is for a company to estimate its transaction needs as future cash flows become more uncertain, the larger the precautionary balance should be (Berk & DeMarzo, 2017). Another motive for holding cash reserves is for speculative (investment) purpose. The speculative motive is to exploit temporary investment

opportunities, for examples: potential bargain purchases emerge when carry out business mergers and acquisitions, a sharp drop in the raw material's price, appealing interest rate, beneficial exchange rate changes (for overseas businesses) and so on (Ross, Westerfield, & Jaffe, 2013). For the majority of businesses, speculative goals can be satisfied via marketable securities and reserve borrowing capacity (Ross, Westerfield, & Jaffe, 2013).

Holding insufficient cash levels can result in possible consequences: loss of cash discounts, potential liquidation, diminished supplier goodwill, tense labor relations (Kaplan Publishing, 2020). Consequently, the objective of effective cash management is a balancing act between the capacity to promptly benefit from opportunities and pay debts when they become due; and reducing cash holdings, an idle asset that is better spent (Kaplan Publishing, 2020). One of the finest models to find out the optimal levels of cash holding is the Miller-Orr model.

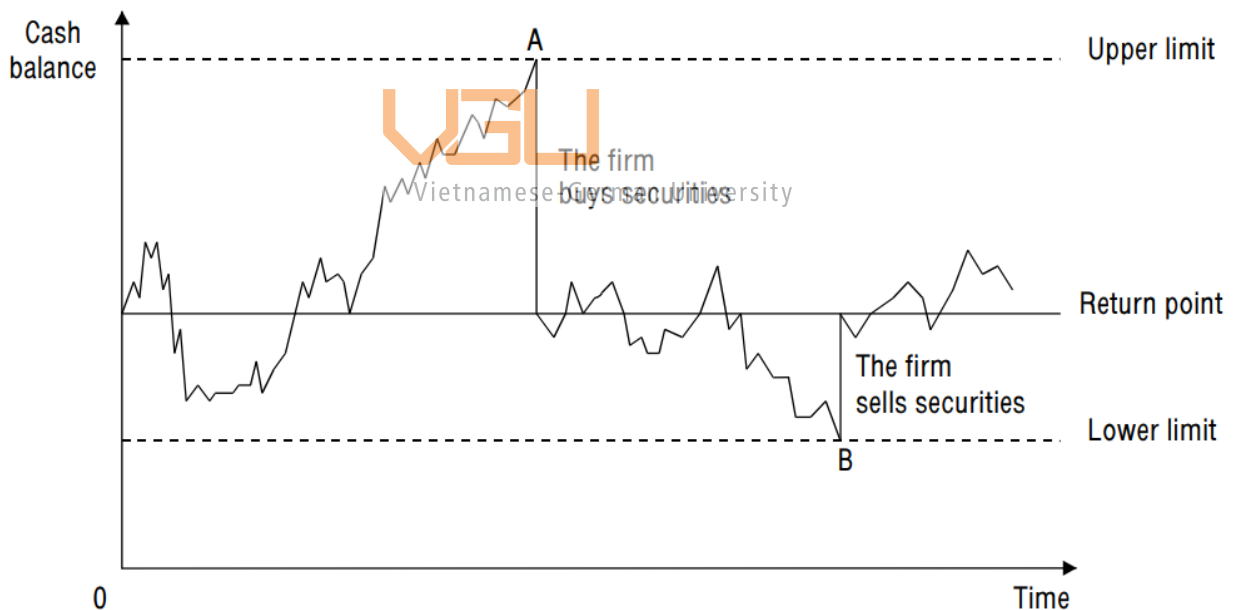


Figure 1. The Miller-Orr model. Adapted from *ACCA Financial Management (FM) – Study Text* (12th ed., p. 131), by BPP Learning Media, 2019, London: BPP Learning Media Ltd. Copyright 2019 by BPP Learning Media Ltd. Adapted with permission.

Figure 1 describes the mechanism of Miller-Orr model overtime. The model regulates cash balance movement by setting the upper limit (point A) and the lower limit (point B) on the cash balance as it fluctuates between these two points. The Miller-Orr model calculates the upper limit after the company specifies the lower limit (Kaplan Publishing, 2020). The company's cash balance is free

to go up and down between these two restrictions, but action must be taken if the cash balance on any given day exceeds either of these limits (Kaplan Publishing, 2020). The system is as follows: as the cash balance hit the upper limit, the firm will buy sufficient marketable securities to return the cash balance to a target level (that is the “return point”) and if the cash balance fall to the lower limit, the firm would sell securities to move the cash balance back to the return point (BPP Learning Media, 2019). The Miller-Orr model can be interpreted by identify the return point and the upper limit using the following formulas: $Return\ point = Lower\ limit + \left(\frac{1}{3} \times Spread\right)$ and $Upper\ limit = Lower\ limit + Spread$ where $Spread = 3 \times \left(\frac{3}{4} \times \frac{Transaction\ cost \times Variance\ of\ cash\ flows}{Interest\ rate}\right)^{\frac{1}{3}}$ (BPP Learning Media, 2019).

2.4. Working capital policies

2.4.1. Working capital investment policies

Working capital investment policies usually refer to strategies in deciding the appropriate level of current assets a company should acquire in specific scenarios. Typically, this is assessed in relation to the amount of overall operational sales generated by the company (Ross, Westerfield, & Jaffe, 2013). The three most effective alternatives of choosing the suitable amount of working capital when making decisions are: relaxed (conservative) policy, restricted (aggressive) policy and moderate policy.

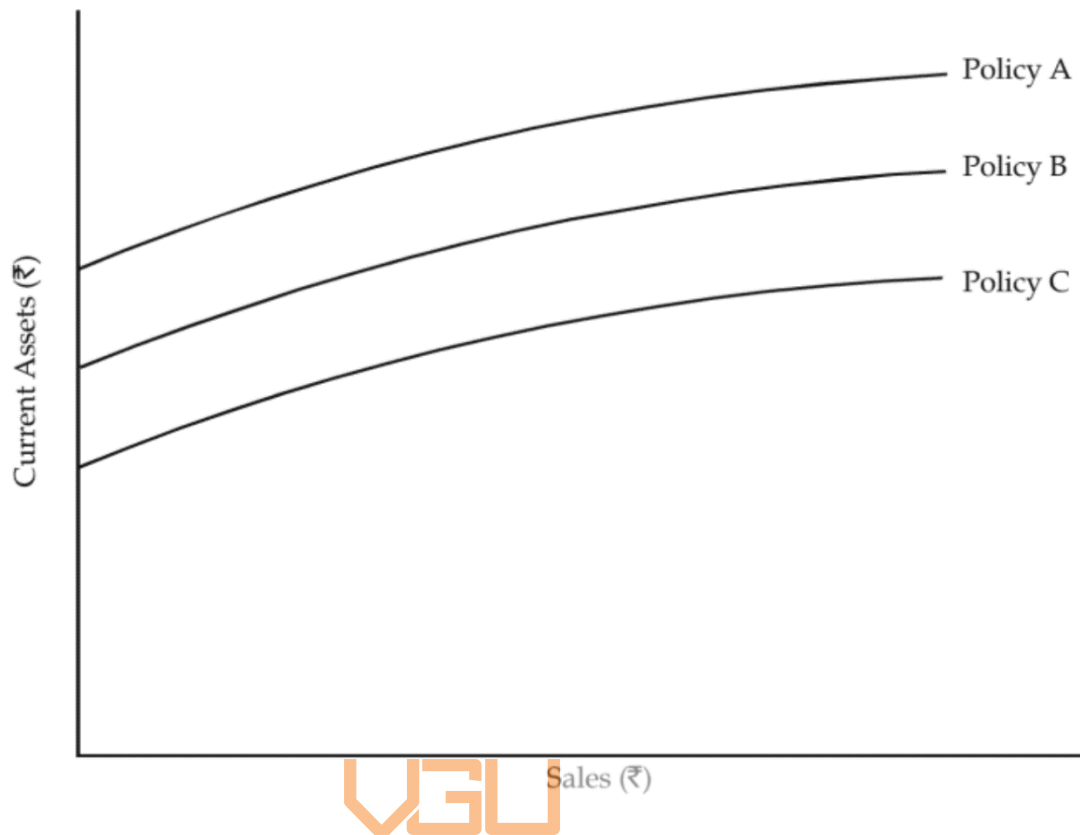


Figure 2. Working capital investment policies. Adapted from *Working capital management* (1st ed., p. 69), by V. K. Bhalla, 2014, New Delhi: S. Chand & Company Pvt. Ltd. Copyright 2014 by V. K. Bhalla. Adapted with permission.

Figure 2 demonstrates the link between the company’s investment in current assets and the corresponding sales under a certain strategy, which is shown by each curve. The “policy A” curve represents the relaxed approach, under which the amount of current assets is maintained as high level and the amount of current liabilities is kept as low level. By keeping a large portion of current assets and low current debts, the firms would reduce the chance of being subjected to the risk of system breakdown – the situation in which the company does not have the required current assets amount to maintain daily operational activities. Sustaining a considerable amount of current assets implies that the companies would raise their cash and marketable securities holdings (Ross, Westerfield, & Jaffe, 2013), and generously extend the credit terms to their customers to boost demand, leading to high volume of receivables (BPP Learning Media, 2019). In addition, the firms would also invest substantially in inventory as well as strive to settle payments with their vendors as quickly as possible to retain their trust, in order to assure the availability of items for trading and

material for production (BPP Learning Media, 2019). However, keeping current assets excessively high would easily lead to rising finance costs and reducing profitability.

The “policy C” curve illustrates the restricted approach. As opposed to relaxed strategy, the restricted strategy seeks to minimize the current assets and keep a relatively high portion of current debts. When applying this policy, firms tend to decrease the portion of cash and marketable securities (Ross, Westerfield, & Jaffe, 2013), and they speed up collection of receivables as they restrict customers to long payment terms (BPP Learning Media, 2019). Furthermore, reducing inventory holding could also be an option as well as prolonging payable settlement terms to suppliers. These alternatives would enhance firm’s profitability due to less finance costs, but they can be disastrous as they may expose the firms to system breakdown risk. Holding too little current assets could lead to several severe problems as follows: losing liquidity due to shortage of cash, cannot retain customers and vendors goodwill as collecting receivables too quickly and pending payables too long, and understocking – a circumstance when firms’ supply of certain products cannot meet demand.



While the relaxed policy cause profitability problem and restricted policy cause liquidity problem, the moderate policy aims to neutralize the effect of those two policies, as depicted by the “policy B” curve. This approach is considered to be the safest since it offers a balance between profitability and liquidity (Bhalla, 2014).

2.4.2. Working capital financing policies

The total of the firm’s current and non-current (fixed) assets determines how much finance it needs. Current assets could be divided into two different types: Temporary (fluctuating) current assets and permanent current assets. Temporary current assets are those influenced by the seasonal or cyclical pattern of firm’s sales (Bhalla, 2014), and fluctuate in accordance with regular business activity (BPP Learning Media, 2019). The amount needed to cover long-term minimum requirements while maintaining regular trading activity is referred to as permanent current asset (BPP Learning Media, 2019). The working capital of the company, which can be financed by either long-term financing (including equity capital) or current liabilities (short-term financing) consist of both temporary current assets and permanent current assets (BPP Learning Media, 2019). There are three policies

that are commonly used to finance working capital: moderate approach, aggressive approach and conservative approach.

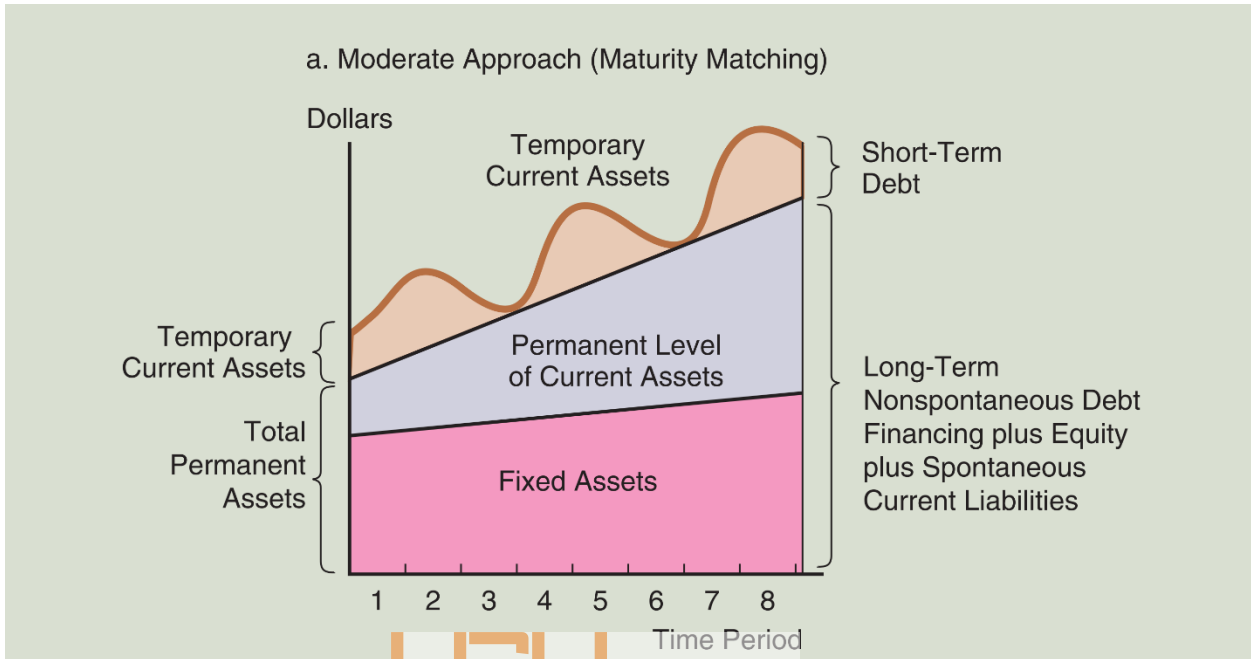


Figure 3. Moderate Approach. Adapted from *Financial Management: Theory and practice* (13th ed., p. 646), by M. C. Ehrhardt, E. F. Brigham, 2011, Mason: South-Western Cengage Learning. Copyright 2011 by South-Western Cengage Learning. Adapted with permission.

As depicted in figure 3, moderate approach (or maturity matching) requires matching asset and liability maturities (Ehrhardt & Brigham, 2011). Long-term capital is used to finance all fixed assets as well as permanent current assets, whereas short-term debt is used to fund temporary current assets (Ehrhardt & Brigham, 2011). Long-term assets are rarely financed by short-term borrowing by businesses. Because short-term interest rates are more volatile than long-term interest rates, this kind of maturity mismatching would require frequent funding and is fundamentally dangerous (Ross, Westerfield, & Jaffe, 2013). As can be seen from figure 3, only the short-term swings depicted at the top of the graph are financed using short-term debt. The reasoning for this is that the company will be paying interest for the usage of money during periods when these funds are not needed if long-term debt is utilized to cover short-term demands. The borrowing and payment schedule for short-term financing would be set up to correspond to the anticipated fluctuations in the current assets using moderate approach to financing, lessening spontaneous financing. This strategy strikes a balance between risk and return by matching the duration of

financing and the duration of investment. However, there exists two constraints that preclude maturity match: first is that the lifetimes of assets are unpredictable, and second is that when financing, some common equity must be utilized, and common equity has no maturity (Ehrhardt & Brigham, 2011).

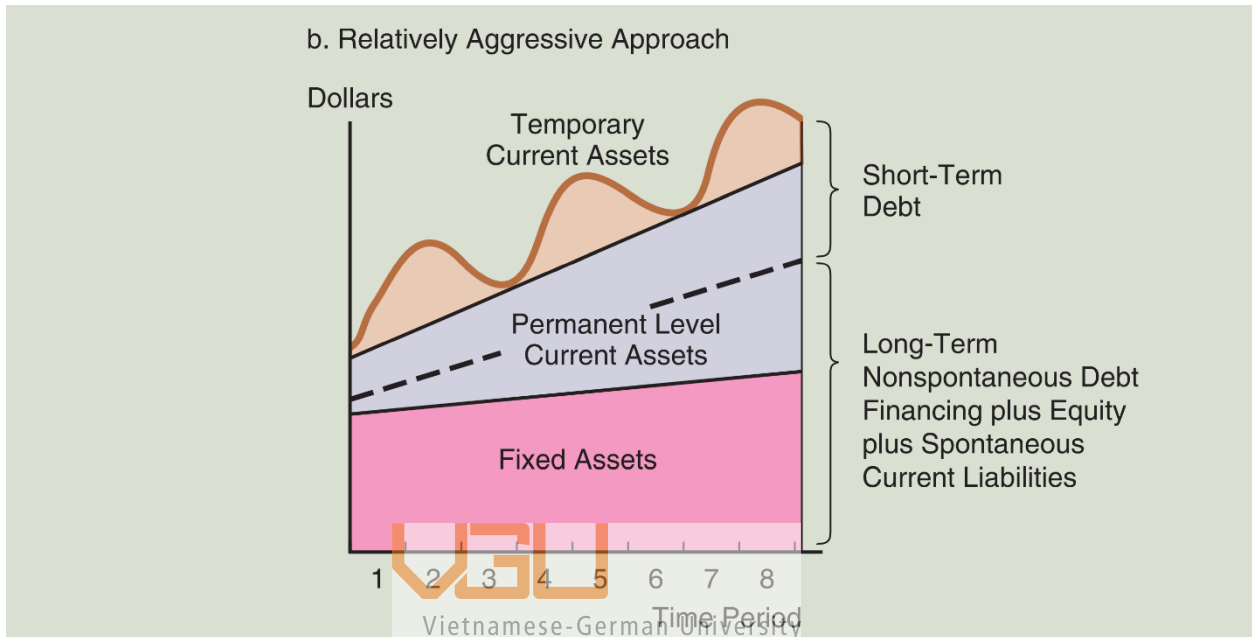


Figure 4. Relatively Aggressive Approach. Adapted from *Financial Management: Theory and practice* (13th ed., p. 646), by M. C. Ehrhardt, E. F. Brigham, 2011, Mason: South-Western Cengage Learning. Copyright 2011 by South-Western Cengage Learning. Adapted with permission.

Figure 4 illustrates the mechanism of aggressive approach. This approach shows that, the company will finance not only all of the fluctuating current assets, but also part of the permanent current assets with short-term credit. This strategy put firms in a highly risky position as it increases the chance of experiencing liquidity and cashflow issues (BPP Learning Media, 2019). Because companies have to frequently refinance the short-term debt at maturity, they are vulnerable to growing interest rate risk. The financing is considered to be more aggressive when the proportion of permanent assets needs funded by current debt is larger (Van Horne & Wachowicz, 2008). Usually, since short-term interest rates are often lower than long-term interest rates, some businesses are ready to take a chance by borrowing a significant amount of money at a low cost in the short term in the expectation of experiencing greater profitability (Ehrhardt & Brigham, 2011).

This is true in the case that the economy is not in recession and the yield curve is upward sloping, for which long-term interest rates is higher than short-term ones (Ehrhardt & Brigham, 2011).

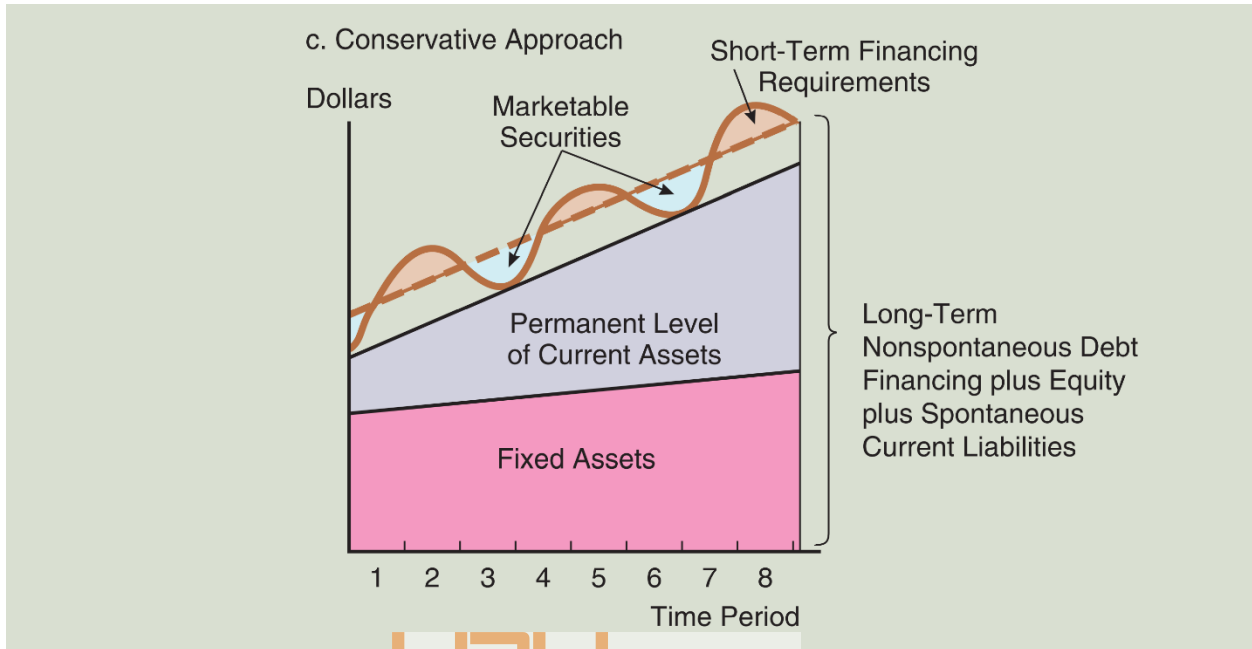


Figure 5. Conservative Approach. Adapted from *Financial Management: Theory and practice* (13th ed., p. 646), by M. C. Ehrhardt, E. F. Brigham, 2011, Mason: South-Western Cengage Learning. Copyright 2011 by South-Western Cengage Learning. Adapted with permission.

The conservative policy characterized in figure 5 indicates that long-term funding is used to finance all fixed assets, permanent current asset and a portion of temporary current assets (BPP Learning Media, 2019). Figure 5 shows that only when the temporary current asset fluctuates significantly and raises the total asset above the dashed line does short-term financing become necessary, and the firm only uses a modest amount of short-term loan to cover its peak needs. On the other hand, there will be excess cash that the business can invest in marketable securities when temporary currents assets are low and total assets fall below the dashed line. This approach is considered to be the safest and most stable among the working capital financing strategies. This strategy's relatively low portion of short-term credit lowers the danger that the business will not be able to settle its debt and lowers the risk brought on by changes in interest rates (Bhalla, 2014). However, due to the significant cost of long-term debt, this approach is not preferred if the company wants to pursue high profit goal.

2.5. Working capital efficiency

Working capital efficiency ratios, commonly referred to as turnover or activity ratios, assess how proficiently a company uses its resources (Van Horne & Wachowicz, 2008). They are crucial ratios for asset management (Clayman, Fridson, & Troughton, 2012), and they display how actively the company uses its assets to generate revenue (Bhalla, 2014). These ratios reveal if the company is investing insufficiently or excessively in short-term and long-term assets. When an asset is invested in too much, the cash locked up in that asset may need to be utilized for more urgent and productive uses (Bhalla, 2014). On the other hand, if the asset is invested in too little, the business may be offering subpar service to its customers or manufacturing its product ineffectively (Bhalla, 2014). The essential ratios are: inventory efficiency, accounts receivable efficiency, accounts payable efficiency, cash conversion cycle.

2.5.1. Inventory efficiency ratios

Inventory days and inventory turnover are the two ratios can be used to assess inventory management performance. Inventory days and inventory turnover ratios are calculated as follows:
$$Inventory\ days = \frac{365}{Inventory\ turnover}$$
 where
$$Inventory\ turnover = \frac{Cost\ of\ goods\ sold}{Average\ inventory}$$
 (Ross, Westerfield, & Jaffe, 2013). The inventory turnover ratio provides information on the frequency with which inventories are converted into receivables through sales over the year (Van Horne & Wachowicz, 2008). Like other ratios, this one must be evaluated in respect to the company's historical and anticipated future ratios as well as in comparison to ratios of other businesses in the same sector, the industry average, or both (Van Horne & Wachowicz, 2008). High inventory turnover ratio means that more efficient (liquid) managing inventory is, but excessively high ratio could really be a sign of keeping inventory level too low and experiencing frequent stockout (Van Horne & Wachowicz, 2008). On the other hand, a decrease in the inventory turnover ratio frequently indicates that the products of the company are slow-moving, perhaps obsolete and uncompetitive (Subramanyam & Wild, 2009). Another way to quantify inventory activities is using inventory days ratio. This ratio reveals the average number of days it takes for inventories to be available for sale (Subramanyam & Wild, 2009). A longer inventory period indicates sluggish business or a build-up of stock, possibly showing that the investment in inventories is getting out of hand.

2.5.2. Accounts receivable efficiency ratios

Assets like receivables need to be financed at a certain cost of capital (Subramanyam & Wild, 2009). Furthermore, receivables include collection risk and necessitate additional expenditure in the form of credit and collection departments (Subramanyam & Wild, 2009). From this standpoint, lowering the volume of receivables lowers these expenses. However, accounts receivable need to be effectively controlled as when we drastically cut receivables with an extremely rigorous credit policy, the cutback will negatively affect sales, resulting in lower profits. Receivable days and receivable turnover are considered to be two indicators that measure the efficiency of accounts receivable management as they discover how well a business uses the credit extended to customers.

They are determined by the following formulas: $Receivables\ days = \frac{365}{Receivable\ turnover}$ where

$Receivable\ turnover = \frac{Credit\ sales}{Average\ receivables}$ (Ross, Westerfield, & Jaffe, 2013). The receivable

turnover shows the average frequency with which accounts receivable are generated by credit sales and are eventually collected over the fiscal year (Clayman, Fridson, & Troughton, 2012). The time from the normal sales to cash collection is shortened as turnover increased (Van Horne & Wachowicz, 2008). Using accounts receivable days (sometimes referred to average collection period) is an alternative approach. This figure reflects the time length accounts receivables are outstanding. Overall, the longer the receivables period, the lower the receivable turnover rate and vice versa (Subramanyam & Wild, 2009).

2.5.3. Accounts payable efficiency ratios

Accounts payable contribute significantly to the financing of current assets. These amounts payable is typically interest-free, making them more affordable than borrowing money to pay for inventory purchases or manufacturing (Subramanyam & Wild, 2009). As a result, firms frequently employ trade credit. The term for this is “leaning on the trade” (Subramanyam & Wild, 2009). The payable days and payable turnover ratios can be utilized for investigating the efficacy of accounts payable and can be computed as follows: $Payables\ days = \frac{365}{Payables\ turnover}$ where

$Payables\ turnover = \frac{Cost\ of\ goods\ sold}{Average\ payables}$ (Ross, Westerfield, & Jaffe, 2013). Ceteris paribus, firms

want to use this inexpensive source of finance as frequently as they can, which result in a lower payable turnover rate and a higher accounts payables level (Subramanyam & Wild, 2009).

Postponing payment to suppliers could be a way to lower the payables turnover rate, but if done too frequently, it might harm the relations with suppliers. A low payables turnover rate features a long payables period. An increase in payables days is frequently an indication of insufficient management of current assets or a lack of long-term financing, which can lead to increasing bank overdraft, excessive usage of extended credit from suppliers and so on (BPP Learning Media, 2019).

2.5.4. Cash conversion cycle

The cash conversion cycle can be used to show how investments in working capital and cash flow are related to one another (BPP Learning Media, 2019). The length of time between when cash leaves a business at the start of the manufacturing process and when it returns is reflected in the level of working capital (Berk & DeMarzo, 2017). Figure 6 describes a simplified cycle from the stage of materials/merchandise procurement, through the production process, finished goods are converted to sales. The process is as follows:

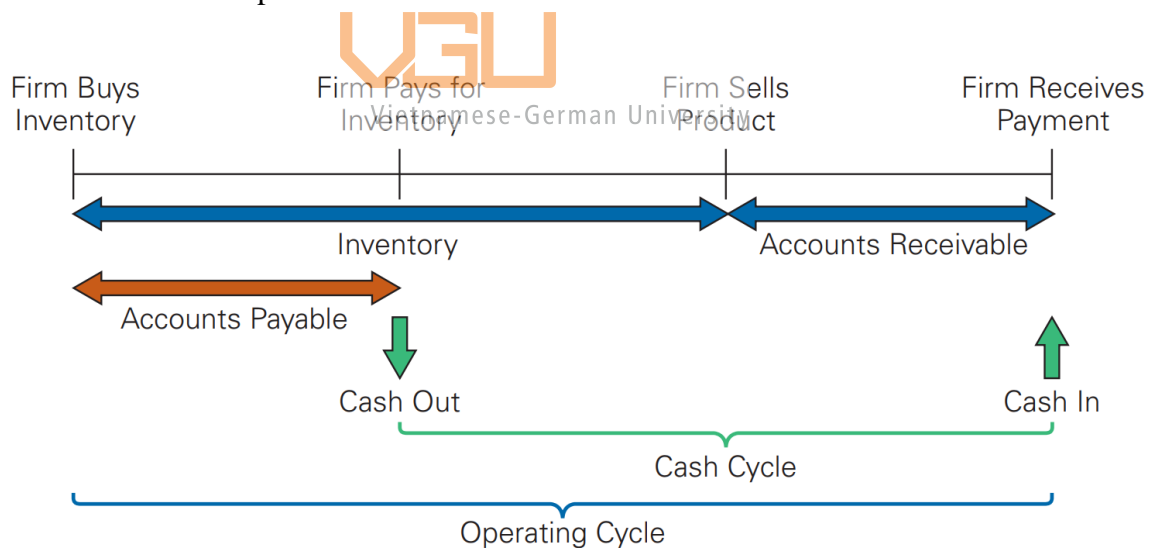


Figure 6. The Cash and Operating Cycles. Adapted from *Corporate finance* (4th ed., p. 951), by J. Berk, P. DeMarzo, 2017, London: Pearson Education Limited. Copyright 2017 by Jonathan Berk and Peter DeMarzo. Adapted with permission.

Firms initially purchase raw materials or finished goods as inventory from its vendors. Typically, they acquire their inventory on credit, meaning that it is not required to pay in full up front or immediately at the time of purchase. After the inventory is delivered, either in the form of raw materials or finished goods, it might remain on the shelf for a while before converting to

receivables. Eventually, the companies could extend their customers credit after the merchandise has been sold, postponing when they will get paid in cash (Berk & DeMarzo, 2017). The whole cycle, from inventory acquisition to cash collection, is referred to as the operating cycle of the firm. This cycle has two phases. First is the stage to get the inventory, calling the inventory period; and second is the stage to collect cash on the sale, calling the receivables period (Ross, Westerfield, & Jaffe, 2013). The operating cycle is determined by combining the inventory period and accounts receivable period: $Operating\ cycle = Inventory\ days + Receivables\ days$ (Ross, Westerfield, & Jaffe, 2013). Comparing a firm's operating cycle with previous year or with other identical businesses in the same industry is helpful since a prolonged operating cycle will typically raise red flags. When assessing a company's current asset requirements, the duration of operating cycle is an essential consideration (Van Horne & Wachowicz, 2008). Factors such as: decisions relating to liquidity-profitability trade-off, managerial effectiveness, terms of trade and industry nature, all affect how long the cycle lasts (Kaplan Publishing, 2020).

When accounts payable period is subtracted from the operating cycle, the cash conversion cycle is determined. The cash conversion cycle can be calculated as follows : $Cash\ Conversion\ Cycle = Operating\ Cycle - Payables\ days$ or $Cash\ Conversion\ Cycle = Inventory\ days + Receivables\ days - Payables\ days$. The time period between cash disbursement to buy inventory and cash collection from sales is called the cash conversion cycle. If the company settle its payment with cash immediately when buying inventory, then the operating cycle and cash conversion cycle would be perfectly identical (Berk & DeMarzo, 2017). Nevertheless, the majority of businesses purchase goods on credit, shortening the period between making a cash investment and receiving cash from such investment (Berk & DeMarzo, 2017). The cash conversion cycle represents a company's investment in working capital as it progresses from production to sales (Kaplan Publishing, 2020). A company has more working capital and more cash on hand to carry out day-to-day needs the longer its cash conversion cycle is. The ideal level is when there is no idle cash or underutilized inventory yet there is no stress on liquid resources (Kaplan Publishing, 2020).

2.6. Firm's profitability

Firm's profitability can be simply understood as the ability to generate and maintain profit of a firm over a normal course of business. The profit which directly impacted by the efficacy of

working capital management is the gross profit, which defined by the following formula: $Gross\ profit = Sales - Cost\ of\ sales$. The way to assess one company's profitability is using profitability ratios. The ratios are classified into two types: those that demonstrate profitability in relation to sales and those that demonstrate profitability in relation to investment (Van Horne & Wachowicz, 2008). They jointly represent the company's operational efficiency as a whole. In this study, gross profit margin will be used as an indicator to assess firm's profitability as well as a dependent variable in investigating the relationship between working capital management and firm's profitability. The formula is as follow: $Gross\ profit\ margin\ (GPM) = \frac{Gross\ profit}{Sales}$.

3. Literature review

There has been various research conducted relating to the investigation of the effect of managing working capital to the firm's profitability. Commonly, working capital efficiency ratios are used by researchers as a measure to back their findings. Shaik (2021) has performed a research looking into the impact of the cash conversion cycle on 100 Saudi Arabian companies' profitability in 9 manufacturing industry from 2008 to 2019. Using return on asset, return on equity, gross operating profit and Tobin's q as indicators for firm's profitability, then regressing by pooled regression model, the study found out that there exists a positive significant relationship between the return on equity, return on asset, Tobin's q and the cash conversion cycle, excluding gross operating profit, where there was a negative correlation to the cash conversion cycle (Shaik, 2021).

Liu & Xu (2022) analyzed the effect of working capital management on profitability of 37 Chinese firms in agricultural sector over the period of 8 years from 2012 to 2019. Their research used descriptive statistic, correlation analysis, ordinary least square regression as well as testing for non-linear effect and robustness and found out that after controlling for corporate characteristic and macroeconomic factors, the accounts receivable period has a convex quadratic relationship on profitability as measured by return on asset, and the accounts payable period is positively correlated with the return on asset (Liu & Xu, 2022). Furthermore, the findings also support that the company size is positively correlated to the return on asset and sales growth, as well as the existence of a negative relationship between firm debt and return on asset (Liu & Xu, 2022).

A similar study was performed by Li (2016), identifying the key elements that influences the working capital practices of over 2000 listed firms in China operating in various industry sectors, and how those variables affect the performance of the companies in the period from 2010 to 2014. The research methodology is to use fixed effect regression for multivariate analysis, in order to gain a better understanding of how the working capital policy as measured by the cash conversion cycle would affect the firms' profitability as measured by the gross operational income (Li, 2016). Their empirical findings show that the Chinese firms are more likely to adopt a conservative working capital policy and the cash conversion cycle is negatively associated to the profitability indicator gross operational income (Li, 2016).

Aldubhani, Wang, Gong, & Maudhah (2022) carried out an empirical study assessing how efficiently working capital management policies affect the listed Qatar manufacturing firms. Their methodology is to use multiple regression model to test for the developed hypotheses, so as to evaluate the association of working capital management and firm's profitability (Aldubhani, Wang, Gong, & Maudhah, 2022). The result indicated that the receivables period and the cash cycle has inverse relationship on firm's profit (Aldubhani, Wang, Gong, & Maudhah, 2022). This means a firm would generate more money if its receivables days and cash conversion cycle were shorter (Aldubhani, Wang, Gong, & Maudhah, 2022). Conversely, payables period and inventory period are positive correlated to the firm's profitability (Aldubhani, Wang, Gong, & Maudhah, 2022). This implies that the longer the inventory and payable days, the greater the firm's profit (Aldubhani, Wang, Gong, & Maudhah, 2022).

Another research was conducted in Jordan by Hayajneh & Yassine (2011). The 53 Jordanian manufacturing companies listed on the Amman Stock Exchange were the subject of this study, which looked at the association of firm's profitability and working capital efficiency ratios from the year 2000 to 2006 (Hayajneh & Yassine, 2011). Their findings reveal a negative correlation between firm's profit and the average period for collecting receivables, the average period for converting inventory to sales, the average period of making payments, firm's leverage ratio, as well as the cash conversion cycle, which measures the effectiveness of working capital (Hayajneh & Yassine, 2011). On the other hand, their result also pointed out a positive relationship between profitability versus firm size, sales growth and current ratio (Hayajneh & Yassine, 2011).

Nguyen, Pham, & Nguyen (2020) examined 119 non-financial Vietnamese listed companies over a 9 year-period from 2010 to 2018 to find out the impact of working capital management on the firms' profitability. Utilizing two statistical regression model, fixed effect model and ordinary least squares model, their research suggest that the cash conversion cycle, together with its three components, including accounts receivable days, accounts payable days, and inventory days have the statistically significant and negative relationship toward the businesses' profitability assessed by return on assets and Tobin's q (Nguyen, Pham, & Nguyen, 2020). Their result indicates that the companies may boost their profits by maintaining the optimal working capital management strategy, which involves quickly collect money from customers and settle payments with vendors, and speeding inventory movement (Nguyen, Pham, & Nguyen, 2020).

Nguyen & Dang (2020) used a sample of 5295 observations to discuss the influence of working capital management on profitability of non-financial Vietnamese listed enterprises on stock exchanges from 2009 to 2018. Their research technique is to utilize generalized least squares model to analyze the linear and non-linear relationships between the working capital efficiency ratios including inventory days, accounts receivable days, accounts payable days and cash cycle, and the return on asset (Nguyen & Dang, 2020). Their study initially discovered a negative correlation between working capital efficiency component and the firm's profitability and finally with the use of quadratic function, they concluded a parabolic relationship (U-shaped) between working capital management and the profitability (Nguyen & Dang, 2020). This result implies an optimal working capital level that balances benefits and costs while maximizing company performance exists (Nguyen & Dang, 2020).

Yusuf (2019) investigates how working capital management practices affect the profitability of the Turkish public companies operating in petroleum, plastic and chemical industry from 2012 to 2016. He used return on asset (ROA) and return on equity (ROE) as indicators for firm's profitability, and the working capital efficiency ratios (accounts receivable period, accounts payable period, inventory period, cash conversion cycle) as indicators for working capital management (Yusuf, 2019). With a sample of 20 firms by using homogenous sampling technique, and hypothesis-testing research approach using regression analysis in addition, he managed to conclude the following results: the ROA is positively correlated with the accounts receivable period, the cash conversion cycle, and is negatively correlated with the inventory period, the accounts payable period; the ROE

is positively correlated with the accounts receivable period, the accounts payable period, and is negatively correlated with the inventory period and the cash conversion cycle (Yusuf, 2019).

Al-Mawsheki, Ahmad, & Nordin (2019) inspect the impact of effective working capital management and working capital policies on the business performance of 143 Malaysian public enterprises in the manufacturing industry over the period of seven years, from 2010 to 2016. The dependent variable is the economic value added (EVA), which they used as an indicator for business performance (Al-Mawsheki, Ahmad, & Nordin, 2019). As for the independent variables, like previous research, they also utilized cash conversion cycle as a metric for the working capital efficiency (Al-Mawsheki, Ahmad, & Nordin, 2019). In addition, they used current asset to total asset ratio as an indicator of working capital investment policy, and current liabilities to total asset ratio as a measure for working capital finance policy (Al-Mawsheki, Ahmad, & Nordin, 2019). By using random effect model for panel data analysis on a sample of 959 observations, they discovered that the economic value added (EVA) – a proxy of business performance for firms, is statistically and negatively correlated with the cash conversion cycle (Al-Mawsheki, Ahmad, & Nordin, 2019). Furthermore, their results also give us insight that the working capital investment policy measured by the current asset to total asset ratio has a positive impact on the performance of firms (Al-Mawsheki, Ahmad, & Nordin, 2019). Meanwhile, on the other hand, the working capital financing policy as measured by the current liabilities to total asset ratio is proved to be having no statistical impact on the firm performance (Al-Mawsheki, Ahmad, & Nordin, 2019). Their empirical study recommended the Malaysian manufacturing companies to shorten the cash conversion cycle and applying conservative approach for working capital policies to enhance their economic performance (Al-Mawsheki, Ahmad, & Nordin, 2019).

Ukaegbu (2014) conducted a study in Africa using the balanced data set of 102 companies in manufacturing filed from 2005 to 2009 in Nigeria, Kenya, Egypt and South Africa, to ascertain the connections between working capital efficiency and business profitability and more importantly, to assess their statistical significance across nations with various industrial levels (Ukaegbu, 2014). The author uses fixed effect model for multivariate regression analysis and find out that, over various industrialization typologies, there is a negative association between profitability, as assessed by net operating profit, and cash conversion cycles (Ukaegbu, 2014). His empirical result also implies that, by lowering the number of receivable collection days, making sure the stocks are

sold off fast, and deferring settlement of current liabilities as long as it does not harm the companies' credit rating, financial managers might bring more benefits and value for the shareholders of the firms (Ukaegbu, 2014).

4. Data collection and methodology

4.1. Data collection

The data utilized in this study mainly comes from secondary source and was gathered from the annual financial statement of 604 listed firms on the Vietnam Stock Exchange for the period of 19 years, from 2001 to 2019. This data set includes mostly information about the financial statements line items of companies, and it does not focus in specific industry but spreads across various industrial and service sectors in the Vietnam economy. This brings a specific and comprehensive view when assessing the impact of working capital management to firms' profitability.

The reason why only listed companies are chosen is that their financial reports are publicly issued and are carefully audited by qualified auditors. This makes their data more reliable than private ones. The data is in panel form and it is unbalanced due to the lack of information when collecting data from the firms' financial statements. This causes the number of observations to be not consistent between the variables. As a result, the assessment technique and results have limitations. However, this is treated as a minor issue that has little impact on the final outcome.

4.2. General model and variables

4.2.1. General model

This study's purpose is to estimate the value of the beta coefficients of all independent variables and the control variables and to see how they influence the dependent variable. We create a generic model that includes all independent variables, control variables, and the dependent variable to determine exactly how the variables interact. The general model taken form as follows:

$$\text{GPM}_{i,t} = \beta_0 + \beta_1 * \text{ARDAY}_{i,t} + \beta_2 * \text{APDAY}_{i,t} + \beta_3 * \text{INTDAY}_{i,t} + \beta_4 * \text{CCC}_{i,t} + \beta_5 * \text{GDP}_{i,t} + \beta_6 * \text{LEV}_{i,t} + \beta_7 * \text{FSIZE}_{i,t} + \epsilon_{i,t}$$

where i is an index for company and t is an index for time, GPM is gross profit margin for company i in year t , ARDAY is accounts receivable days for company i in year t , APDAY is accounts

payable days for company i in year t, INTDAY is inventory days for company i in year t, CCC is cash conversion cycle for company i in year t, GDP is the Vietnamese annual GDP growth rate, LEV is leverage ratio of firm i in year t, FSIZE is size of firm i in year t.

4.2.2. Dependent variable

Our research will investigate the impact of managing firms' working capital on Vietnamese firms' profitability. We use gross profit margin as a proxy for firm's profitability as we want to capture the effect of working capital management on the income that associated with the main production and business activities of the enterprises. Therefore, gross profit margin plays a role as dependent variable, and is calculated by firm total revenue subtracted for cost of goods sold then divided by total revenue.

4.2.3. Primary independent variables

Independent variables are accounts receivable days (ARDAY), accounts payable days (APDAY), inventory days (INTDAY) and cash conversion cycle (CCC) respectively. Using working capital efficiency ratios as independent variables, we manage to see how effectively the working capital policy affects the firm profit and to investigate whether their relationship is statistically significant.

The accounts receivable days is used as a stand-in for determining the company's collection policy. It is calculated by $\left(\frac{\text{Average trade accounts receivable}}{\text{Total sales}} \times 365\right)$. As for the payment policy to the firms' vendors, we take the average number of days accounts payable to measure the settlement term. We compute it by $\left(\frac{\text{Average trade accounts payable}}{\text{Cost of good sold}} \times 365\right)$. Moreover, we use average inventory period as an indicator for the holding stocks policy and it is measure by $\left(\frac{\text{Average inventory}}{\text{Cost of goods sold}} \times 365\right)$. Furthermore, the cash conversion cycle is the last main independent variable. It measures the period from the moment cash is paid for inventory until the collection of receivables for cash and it is calculated by *Inventory days + Account Receivable days – Account Payable days*.

4.2.4. Control variables

The control variables are GDP growth rate per annum (GDP), firms leverage ratio (LEV) and size of firms (FSIZE). The GDP growth rate is used to assess whether the state of economy affects

profitability of the firms. Firms leverage ratio is calculated by taking the firm's long-term debt divided by the total equity, to investigate the effect of borrowings to the firms' profitability. Lastly, we took the natural logarithm of total asset to calculate the size of Vietnamese firms.

4.3. Research methodology

In order to provide a summary of the variables and basic information about each variable in the dataset, we first utilize the descriptive statistic. Then we use Pearson correlation analysis to assess the correlation between the variables, and to measure the strength and the direction of the linear relationships of the variables.

Our empirical research was conducted using multiple regression analysis. Since it enables us to explicitly account for several different factors that simultaneously impact the dependent variable, multiple regression analysis is more suitable to *ceteris paribus* analysis (Wooldridge, 2019). It could be used for causal inference in circumstances where simple regression analysis might be deceptive since multiple regression models can include various explanatory factors that may be connected (Wooldridge, 2019).


Vietnamese-German University

Because the data set of the Vietnamese listed firms is in panel form, we utilize fixed effect model (FEM) and random effect model (REM) to analyze the impact of working capital management to the firms' profitability. According to Hill, Griffiths, & Lim (2011), fixed effect model taken the form:

$$y_{it} = \beta_{1i} + \beta_2 * x_{2it} + \beta_3 * x_{3it} + e_{it}$$

In this regression model, the intercept is expected to account for all behavioral variations among individual, also known as individual heterogeneity, and "individual intercepts are included to control for individual-specific, time-invariant characteristics" (Hill, Griffiths, & Lim, 2011). As stated by Hill, Griffiths, & Lim (2011), the random effect model has the form:

$$y_{it} = \beta_1 + \beta_2 * x_{2it} + \beta_3 * x_{3it} + e_{it} + u_{it}$$

In random effect model, it is also assumed that all individual differences are captured by the intercept, and assumed to be random and uncorrelated with the explanatory variables in the model (Hill, Griffiths, & Lim, 2011).

We utilize Hausman test in order to decide which model, fixed effect or random effect, is appropriate for the regression. We form the hypothesis for the Hausman test, H_0 : random effect model is appropriate, versus H_1 : fixed effect model is appropriate, with the level of significant at 5%. When the p-value of the Hausman test is smaller than 0.05 (5% significance level), we reject the null hypothesis and conclude that the fixed effect model is more appropriate for regression. In contrast, when the p-value is larger than 0.05 (5% significance level), we do not reject the null hypothesis, thus we conclude that the random effect model is appropriate.

In order to detect multicollinearity, we employ the most common tool which is the variance inflation factor (VIF). It is calculated as follows: $VIF = \frac{1}{(1-R^2)}$ (Wooldridge, 2019). The threshold value researchers usually set is 10. If the VIF exceed 10, it can be concluded that the degree of multicollinearity is problematic (Wooldridge, 2019).

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As for the test for autocorrelation, we use the Wooldridge test for autocorrelation at 5% level of significance and under the hypothesis, H_0 : no first order-autocorrelation. If the p-value is smaller than 0.05 (5%), we reject the null hypothesis and conclude there exists autocorrelation in our model. On the other hand, if the p-value is larger than 0.05 (5%), we do not reject null hypothesis and conclude that our model is free from autocorrelation.

5. Empirical results and discussion

5.1. Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GPM	5292	24.032	22.992	-541.679	100
ARDAY	5289	87.568	773.923	0	51265.855
APDAY	5237	103.771	775.661	0	29806.592
INTDAY	5233	262.07	3886.691	0	181371.63
CCC	5225	246.97	3660.582	-15580.232	165390.33
GDP	5944	6.392	.663	2.789	9.54
LEV	4347	29.814	58.281	0	343.662
FSIZE	6179	13.683	1.838	3.584	21.122


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Table 1. Descriptive statistics.

Table 1 illustrates the descriptive statistics of both the dependent and independent variables in the model. The number of observations between the variables is not consistent due to the unbalanced nature of the panel data. Looking into the dependent and independent variables, there are some significant points. The average gross profit margin (GPM) of the Vietnamese listed firms is about 25.024 % per year. This level of profitability is considered to be ideal and reasonably accepted when doing business in a developing economy like Vietnam. The standard deviation of the GPM variable is 22.992 % and the level of profit margin ranges from -541.679 % to 100 %. The working capital efficiency ratios are used as indicators to assess the effectiveness of managing working capital of Vietnamese listed firms. The average period for collecting receivables from customers (ARDAY) is about 88 days, shorter than that for paying payables to suppliers (APDAY) which is 104 days. This implies that, in average term, Vietnamese firms have enough time to maintain a sufficient liquidity, from collecting money to payment settlement with suppliers. The average time for holding inventory of the firms (INTDAY) is 262 days and the average cash conversion cycle

(CCC) is 247 days. The minimum values for ARDAY, APDAY, INTDAY are all equal to zero day. This indicates that there are some firms in the sample that do not use credit purchase and some of them do not even hold stock. The minimum value for cash conversion cycle (CCC) is -15580 days. Having negative cash conversion cycle is considered normal. As there are some companies, especially retailers, due to their nature – that is fast paced in collecting money and short inventory period, plus they can lengthen the payables period, this causes their cash cycle become negative. The standard deviation of the variables: ARDAY, APDAY, INTDAY, CCC is quite large, this shows that the values are spread out wider from their mean. The values are 774 days, 776 days, 3887 days, 3660 days respectively. The mean value of GDP growth rate is about 6.392 %. With this average growth rate, Vietnam can be considered to have a stable economy over the years. The average leverage ratio is approximately 30% and it is considered safe and ideal as the debt portion is lower the equity portion. It implies that most of Vietnamese businesses are managing the risk from debt quite well and are capable of maintaining debt solvency.

5.2. Correlation analysis



Variable	GPM	ARDAY	APDAY	INTDAY	CCC	GDP	LEV	FSIZE
GPM	1.000							
ARDAY	-0.083	1.000						
APDAY	-0.047	0.650	1.000					
INTDAY	-0.138	0.121	0.412	1.000				
CCC	-0.145	0.066	0.256	0.984	1.000			
GDP	0.003	0.028	0.021	-0.004	-0.006	1.000		
LEV	0.090	-0.000	0.016	-0.002	-0.006	-0.029	1.000	
FSIZE	0.087	-0.002	0.017	0.020	0.017	0.115	0.255	1.000

Table 2. Pearson correlation.

Table 2 demonstrates the correlation coefficients of the dependent variable, the independent variables and the control variables and points out their statistical relationships. In brief, the figure tells us that all the primary independent variables (ARDAY, APDAY, INTDAY, CCC) negatively impact the dependent variable GPM, whereas the control variables (GDP, LEV, FSIZE) influence dependent variable GPM positively. It also shows that there will be a multicollinearity issue if we include the two variables INTDAY and CCC in the same regression model, as indicated by the extremely high correlation coefficient between them.

The correlation coefficient between the ARDAY and GPM is -0.083, representing a negative relationship between the accounts receivable period and the firms' profit as measured by gross profit margin. This means that the firm's profit would increase if the firm tried to shorten receivables collection period. The connection between the accounts payable period and the firm's profitability is negatively correlated, as seen by the correlation coefficient of -0.083 between the APDAY and GPM. This implies that the sooner the firms settle their debt with vendors, the higher their earnings. The inventory holding period and the cash conversion cycle both inversely affect the firms' profit, as indicated by their correlated coefficient of -0.138 and -0.145. This result suggests the companies can improve their profitability by quickly selling out their inventory and collecting cash. The result also imposes stronger negative relationships of the inventory days and cash cycle toward the firms' profit rather than the relationships of accounts receivable and accounts payable period toward the firms' profit, as evidenced by the correlation coefficient between the INTDAY and CCC toward GPM is closer to -1 than the correlation coefficient between the ARDAY and APDAY toward GPM. Only looking at the correlation coefficient alone might reveal a relationship's strength and direction. It does not expressly state what percentage of the variance in one variable may be explained by the other and cannot be used to infer causality.

5.3. Multiple regression analysis

5.3.1. FEM and REM: Before adjustment for multicollinearity

Table 3 and 4 show the result of the regression of the fixed effect model and random effect model when we in turn evaluate the significance of each of the working capital efficiency ratios to the gross profit margin. By grouping each of the independent variable (each working capital efficiency

subject: ARDAY, APDAY, INTDAY, CCC) with the control variables (GDP, LEV, FSIZE) and regress to the dependent variable GPM, we get the following four models:

$$\text{Model 1: } GPM_{i,t} = \beta_0 + \beta_1 * ARDAY_{i,t} + \beta_2 * GDP_{i,t} + \beta_3 * LEV_{i,t} + \beta_4 * FSIZE_{i,t} + \varepsilon_{i,t}$$

$$\text{Model 2: } GPM_{i,t} = \beta_0 + \beta_1 * APDAY_{i,t} + \beta_2 * GDP_{i,t} + \beta_3 * LEV_{i,t} + \beta_4 * FSIZE_{i,t} + \varepsilon_{i,t}$$

$$\text{Model 3: } GPM_{i,t} = \beta_0 + \beta_1 * INTDAY_{i,t} + \beta_2 * GDP_{i,t} + \beta_3 * LEV_{i,t} + \beta_4 * FSIZE_{i,t} + \varepsilon_{i,t}$$

$$\text{Model 4: } GPM_{i,t} = \beta_0 + \beta_1 * CCC_{i,t} + \beta_2 * GDP_{i,t} + \beta_3 * LEV_{i,t} + \beta_4 * FSIZE_{i,t} + \varepsilon_{i,t}$$

5.3.1.1. Fixed effect model (FEM)

Variable	Model 1		Model 2		Model 3		Model 4	
	β	VIF	β	VIF	β	VIF	β	VIF
ARDAY	-0.00515*** [-5.20]	1.08						
APDAY			-0.00121*** [-2.86]	1.02				
INTDAY					-0.00114*** [-11.70]	1.01		
CCC							-0.00120*** [-11.92]	1.01
GDP	-1.482*** [-3.08]	55.25	-1.571*** [-3.29]	55.22	-1.584*** [-3.39]	55.22	-1.618*** [-3.46]	55.22
LEV	0.0130* [1.67]	1.30	0.0137* [1.76]	1.30	0.0141* [1.86]	1.30	0.0147* [1.93]	1.30
FSIZE	1.569*** [2.75]	56.84	2.036*** [3.54]	56.89	2.094*** [3.73]	56.93	2.178*** [3.88]	56.93
Constant	11.74 [1.60]		5.676 [0.77]		5.085 [0.71]		4.135 [0.57]	
N	3568		3566		3566		3566	
R-sq	0.016		0.011		0.051		0.052	

Table 3. Fixed effect regression for model 1, model 2, model 3 and model 4.

T-statistics in brackets.

*, **, and *** indicate $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively.

As shown in table 3, the result of FEM is interpretable as all the independent variables have the statistical meaning to the dependent variable GPM, except for the appearance of multicollinearity between the two control variables GDP and FSIZE. As can be seen from the regression result, across four models, the relationship between the ARDAY, APDAY, INTDAY, CCC, GDP and the

dependent variable GPM is negative, while the LEV and FSIZE are positively correlated to the GPM. Model 1 with 3568 observations, assessing the influence of accounts receivable days on the firms' profitability measured by gross profit margin. The result of fixed effect model showed a negative relationship between the receivable period and the firm's gross profit margin at the significant level of 1 %, with the beta coefficient of -0.00515. The relationship between the gross profit margin and the control variables is also statistically significant at 1% and 10%. In particular, if the GDP increase by one unit, the firms' gross profit margin will decrease by 1.482 units accordingly at 1% significant level. When the LEV and FSIZE increase by one unit, the GPM will also increase correspondingly by 0.0130 unit and 1.569 unit, as they are positively correlated to the gross profit margin at 10% and 1% respectively. The R-square is 0.016, which implies that the changes ARDAY explain for about 1.6% for the changes in GPM. Observing 3566 samples, model 2 evaluates the impact of accounts payable days to the gross profit margin. Their statistical relationship is also negative and significant at 1%, with the beta coefficient of -0.00121. The beta coefficient of the control variables is as follows: -1.571 for GDP, 0.0137 for LEV and 2.036 for FSIZE and their level of significance is 1% for GDP and FSIZE, 10% for LEV. The R-square is 0.011, indicates that the variation in gross profit margin only be explained by the accounts payable days approximately 1.1%. With 3566 observations, model 3 measures the impact of inventory days variable to the firm gross profit margin. The result also shows us a negative correlation between inventory period and firms' gross profit margin at significant level of 1% and beta coefficient of -0.00114. The control variables are also significantly correlated to the gross profit margin at 1% and 10%, with the beta of -1.584 for GDP, 0.00141 for LEV and 2.094 for FSIZE. The model 4 also examines 3566 observations, bring us the result for the assessment of the effect of cash conversion cycle on the firms' gross profit margin. It shows a negative correlation between GPM and CCC at 1% level significance, the beta is -0.00120. The beta coefficient of control variables is respectively -1.618 for GDP, 0.00147 for LEV, 2.178 for FSIZE and significant at 1% for GDP and FSIZE, at 10% for LEV. The VIF coefficient of the two variables GDP and FSIZE is significantly large across 4 models (55.25 and 56.84 in model 1, 55.22 and 56.89 in model 2, 55.22 and 56.93 in model 3, 55.22 and 56.93 in model 4). When the VIF coefficient is larger than 10, there exists multicollinearity problem in the model, to some extent it can be accepted if the coefficient is not too large. However, in this case, with the excessively high VIF, ignoring such problems might lead to unreliability of our assessment.

5.3.1.2. Random effect model (REM)

Variable	Model 1		Model 2		Model 3		Model 4	
	β	VIF	β	VIF	β	VIF	β	VIF
ARDAY	-0.00535*** [-5.47]	1.08						
APDAY			-0.00140*** [-3.45]	1.02				
INTDAY					-0.00112*** [-12.05]	1.01		
CCC							-0.00119*** [-12.28]	1.01
GDP	-1.243*** [-2.66]	55.25	-1.276*** [-2.75]	55.22	-1.317*** [-2.89]	55.22	-1.338*** [-2.94]	55.22
LEV	0.0161** [2.26]	1.30	0.0165** [2.33]	1.30	0.0166** [2.39]	1.30	0.0170** [2.45]	1.30
FSIZE	1.321*** [3.29]	56.84	1.561*** [3.88]	56.89	1.634*** [4.11]	56.93	1.667*** [4.19]	56.93
Constant	12.97** [2.33]		9.636* [1.73]		9.053* [1.65]		8.714 [1.59]	
N	3568		3566		3566		3566	
R-sq								

Table 4. Random effect regression for model 1, model 2, model 3 and model 4.

T-statistics in brackets.

*, **, and *** indicate $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively.

Table 4 gives us insights on the regression results of our four models using random effect model. Similar to FEM, the results in REM are also interpretable since all of the independent variables exhibit statistically significant relationships to the dependent variable GPM, with the exception of the presence of multicollinearity between the two control variables GDP and FSIZE. According to the regression results, the correlation between the ARDAY, APDAY, INTDAY, CCC, GDP, and the dependent variable GPM is negative in all four models, however the LEV and FSIZE has a positive impact on the GPM. Similar to the FEM case, the number of observations for four models remain unchanged, 3568 for model 1, 3566 for model 2, 3 and 4. The relationship between the ARDAY, APDAY, INTDAY, CCC and GPM is negative, implying shortening the receivable days, payable days, inventory days and the cash cycle result in higher profit to Vietnamese firms and vice versa. Specifically, if we hold other factors fixed, and then change ARDAY, APDAY, INTDAY, CCC by one unit, the gross profit margin will change correspondingly by -0.00535, -0.00140, -0.00112, -0.00119 unit. As regarding the control variables, comparing in the case of

running FEM, the result changed in the significant level of the LEV variable across four models, changing from 10% to 5% of significance. The relationship between the control variables and the dependent variable GPM when we run regression with REM has no difference compared to when we regression with FEM, only changes the beta coefficient. And the remaining problem is still the multicollinearity phenomenon, as the VIF coefficient of the two control variables GDP and FSIZE are larger than 10, indicates serious multicollinearity problem in our four models. The results show that letting these two control variables in the same model is not an ideal way.

5.3.2. FEM and REM: After adjustment for multicollinearity

In order to solve the multicollinearity problem, we split our first four models into eight models, without having the variable GDP and the variable FSIZE stay in the same model.

5.3.2.1. Effect of accounts receivable period on profitability

$$\text{Model 1a: } GPM_{i,t} = \beta_0 + \beta_1 * ARDAY_{i,t} + \beta_2 * GDP_{i,t} + \beta_3 * LEV_{i,t} + \epsilon_{i,t}$$

$$\text{Model 1b: } GPM_{i,t} = \beta_0 + \beta_1 * ARDAY_{i,t} + \beta_2 * FSIZE_{i,t} + \beta_3 * LEV_{i,t} + \epsilon_{i,t}$$

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Variable	Model 1a				Model 1b			
	FEM		REM		FEM		REM	
	β	VIF	β	VIF	β	VIF	β	VIF
ARDAY	-0.00525*** [-5.30]	1.08	-0.00542*** [-5.54]	1.08	-0.00284*** [-3.41]	1.06	-0.00299*** [-3.64]	1.06
GDP	-1.073** [-2.35]	1.29	-0.885* [-1.95]	1.29				
FSIZE					0.911* [1.82]	1.32	1.028*** [2.75]	1.32
LEV	0.0163** [2.11]	1.22	0.0205*** [2.92]	1.22	0.0193*** [2.61]	1.26	0.0212*** [3.11]	1.26
Constant	30.20*** [10.22]		28.30*** [9.33]		10.85 [1.60]		8.548* [1.69]	
N	3571		3571		3842		3842	
R-sq	0.013				0.007			
P-value (Hausman)	0.0001				0.4221			
P-value (Autocorrelation)	0.0887						0.0364	

Table 5. Regression results for model 1a and model 1b.

T-statistics in brackets.

*, **, and *** indicate $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively.

Table 5 brings us the results of the regression of model 1a and model 1b when using fixed effect model and random effect model for each. Model 1a regresses GPM on ARDAY, GDP, LEV while model 1b regresses GPM on ARDAY, FSIZE, LEV. The number of observations in model 1a is 3571 and in model 1b is 3842. The result shows that, in both model 1a and 1b, either using FEM or REM, the independent variables and the control variables are statistically significant to the dependent variable GPM, at the level of significant of 1%, 5% and 10%.

When using fixed effect model and random effect model for model 1a, the result is the same in the two cases. They both reflect a negative relationship between the accounts receivable days and the gross profit margin at the significant level of 1%, with the beta coefficient of -0.00525 and -0.00542 respectively. This means when holding other factors constant, if the accounts receivable days decrease by one unit then the firm gross profit margin will increase by 0.00525 unit in the case of FEM and by 0.00542 unit in the case of REM. The GDP growth rate also has the negative impact on GPM when using FEM and REM to regress, with the coefficient of -1.073 and -0.885 at 5% and 10% significant level respectively. The LEV variable affects GPM positively at 5% significant level when using FEM and at 1% significant level when using REM, with the coefficient of 0.0163 and 0.0205 correspondingly. The R square is 0.013 when using FEM, this implies that the ARDAY variable and the control variables only explain about 1.3 % for the changes in the GPM variable. The VIF coefficient of each variable in both cases are all smaller than 10, indicates that there is no existence of multicollinearity in our model. We use Hausman test for deciding which of the regression model, FEM and REM, is better. The p-value of the Hausman test is 0.0001, indicates that FEM is better for model 1a. We then test for the autocorrelation when using FEM, the p-value is 0.0887 (8.87%), this value is larger than 5%, therefore there is no autocorrelation in our model.

As for model 1b, the accounts receivable period also has a negative correlation to the firm's profitability measured by gross profit margin. The beta coefficient is -0.00284 in case of FEM and -0.00299 in case of REM, at the level of significant of 1%. This implies if other factors are fixed, when ARDAY changes by one unit, GPM will change by -0.00284 unit and -0.00299 unit correspondingly. The FSIZE have positive correlation to the GPM, with coefficient of 0.911 at 10% significant level in case of FEM and with coefficient of 1.028 at 1% significant level in case of REM. LEV variable have positive relationship to the GPM variable with statistical significance of 1% in both cases, and the beta coefficient is 0.0193 for FEM and 0.0212 for REM. Similar to

model 1a, the VIF coefficient is smaller than 10, implies that no multicollinearity problem in our model. The p-value of the Hausman test is 0.4221, this means that it is better to use REM to analyze model 1b. The p-value in autocorrelation test is 0.0364 (3.64%) smaller than 5%, there exists autocorrelation problem in our model. The result in both model 1a and 1b after adjusted for multicollinearity is similar to the result in model 1 before adjusted for multicollinearity. That is the relationship between the accounts receivable period and the firm's profitability is negative and statistically significant at 1%, either using FEM or REM. This means that this result is reliable to use and interpret. This relationship showed that the shorter the accounts receivable period, the higher the profit of Vietnamese firm and vice versa.

5.3.2.2. Effect of accounts payable period on profitability

$$\text{Model 2a: } \text{GPM}_{i,t} = \beta_0 + \beta_1 \cdot \text{APDAY}_{i,t} + \beta_2 \cdot \text{GDP}_{i,t} + \beta_3 \cdot \text{LEV}_{i,t} + \varepsilon_{i,t}$$

$$\text{Model 2b: } \text{GPM}_{i,t} = \beta_0 + \beta_1 \cdot \text{APDAY}_{i,t} + \beta_2 \cdot \text{FSIZE}_{i,t} + \beta_3 \cdot \text{LEV}_{i,t} + \varepsilon_{i,t}$$

Variable	Model 2a				Model 2b			
	FEM		REM		FEM		REM	
GPM	β	VIF	β	VIF	β	VIF	β	VIF
APDAY	-0.00131*** [-3.11]	1.02	-0.00146*** [-3.58]	1.02	-0.000918** [-2.30]	1.02	-0.00110*** [-2.85]	1.02
GDP	-1.039** [-2.29]	1.24	-0.854* [-1.89]	1.24				
FSIZE					1.270** [2.53]	1.28	1.235*** [3.31]	1.28
LEV	0.0178** [2.32]	1.22	0.0217*** [3.11]	1.22	0.0192*** [2.63]	1.26	0.0211*** [3.12]	1.26
Constant	29.62*** [10.08]		27.76*** [9.20]		5.810 [0.85]		5.598 [1.10]	
N	3569		3569		3840		3840	
R-sq	0.007				0.007			
P-value (Hausman)	0.0001				0.2319			
P-value (Autocorrelation)	0.0731						0.0366	

Table 6. Regression results for model 2a and model 2b.

T-statistics in brackets.

*, **, and *** indicate $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively.

Table 6 provides the regression results for models 1a and 1b utilizing the fixed effect model and the random effect model, respectively. Model 2a regresses GPM on APDAY, GDP, LEV, whereas

model 2b regresses GPM on APDAY, FSIZE, LEV. There are 3569 observations in model 2a and 3840 in model 2b. The results demonstrate that the main independent variable APDAY and the control variables (GDP, FSIZE, LEV) are statistically significant to the dependent variable GPM in both models 2a and 2b, whether employing FEM or REM, at the level of significance of 1%, 5%, and 10%.

The outcome is the same in both cases when utilizing the fixed effect model and the random effect model for model 2a. With beta coefficients of -0.00131 and -0.00146, respectively, they both demonstrate a negative association between the accounts payable days and the gross profit margin at the significant threshold of 1%. Thus, if the accounts payable days drop by one unit while all other variables remain the same, the firms' gross profit margin will rise by 0.00131 unit (for FEM) and 0.00146 unit (for REM) and vice versa. When using FEM and REM to regress, the GDP growth rate likewise has a negative effect on GPM, with beta coefficients of -1.039 and -0.854 at the 5% and 10% significant level, correspondingly. When using FEM, the LEV variable significantly affects GPM at a level of 5%, and when using REM, it significantly affects GPM at a level of 1%, with coefficients of 0.0178 and 0.0217, respectively. By using FEM, the R square is 0.007, which suggests that the APDAY variable and the control variables only account for 0.7% of the variations in the GPM variable. There is no multicollinearity in our model, as shown by the VIF coefficients of every variable in both scenarios being less than 10. To determine whether regression model, FEM or REM, is superior, we utilize the Hausman test. The Hausman test has a p-value of 0.0001, indicating that FEM is superior for model 2a. When we test autocorrelation for FEM, the p-value is 0.0731 (7.31%), which is greater than 5%, indicating that there is no autocorrelation in our model.

According to model 2b, the accounts payable term has a negative connection with profitability as evaluated by the gross profit margin. At the 1% level of significance (for FEM) and 5% level of significance (for REM), the beta coefficient for APDAY is -0.00918 and -0.00110 correspondingly. This means that if all other variables remain constant, when ARDAY changes by one unit, GPM changes by -0.00918 unit and -0.00110 unit, respectively. With a coefficient of 1.270 at a 5% significant level for FEM and a coefficient of 1.235 at a 1% significant level for REM, the FSIZE have a positive association to the GPM. In both situations, the LEV variable has a statistically significant positive connection with the GPM variable with a beta coefficient of 0.0192 for the FEM and 0.0211 for the REM at 1%. Similar to model 2a, the VIF coefficient being less than 10

indicates that our model does not have a multicollinearity issue. The Hausman test's p-value of 0.2319 implies that it is preferable to examine model 2b using REM. There is an autocorrelation issue in our model, as evidenced by the autocorrelation test's p-value of 0.0366 (3.66%), which is less than 5%. The outcome in models 2a and 2b after multicollinearity adjustment is identical to the outcome in model 2 before multicollinearity adjustment. This association between the accounts payable term and business profitability is negative and statistically significant at 1%, whether using FEM or REM. This signifies that the outcome is reliable to use and understand. This correlation demonstrates that the Vietnamese company's profit increased with shorter accounts payable period and vice versa.

5.3.2.3. Effect of inventory period on profitability

$$\text{Model 3a: } \text{GPM}_{i,t} = \beta_0 + \beta_1 \cdot \text{INTDAY}_{i,t} + \beta_2 \cdot \text{GDP}_{i,t} + \beta_3 \cdot \text{LEV}_{i,t} + \varepsilon_{i,t}$$

$$\text{Model 3b: } \text{GPM}_{i,t} = \beta_0 + \beta_1 \cdot \text{INTDAY}_{i,t} + \beta_2 \cdot \text{FSIZE}_{i,t} + \beta_3 \cdot \text{LEV}_{i,t} + \varepsilon_{i,t}$$

Variable	Model 3a				Model 3b			
	FEM		REM		FEM		REM	
GPM	β	VIF	β	VIF	β	VIF	β	VIF
INTDAY	-0.00114*** [-11.71]	1.00	-0.00112*** [-12.01]	1.00	-0.00114*** [-11.78]	1.01	-0.00112*** [-12.11]	1.01
GDP	-1.039** [-2.34]	1.22	-0.877** [-1.98]	1.22				
FSIZE					1.318*** [2.68]	1.26	1.293*** [3.50]	1.26
LEV	0.0185** [2.46]	1.22	0.0220*** [3.21]	1.22	0.0193*** [2.69]	1.26	0.0210*** [3.16]	1.26
Constant	29.72*** [10.32]		28.03*** [9.47]		5.303 [0.80]		4.995 [1.00]	
N	3569		3569		3840		3840	
R-sq	0.047				0.045			
P-value (Hausman)	0.0010				0.8316			
P-value (Autocorrelation)	0.0682						0.0291	

Table 7. Regression results for model 3a and model 3b.

T-statistics in brackets.

*, **, and *** indicate $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively

The regression results for two models 3a and 3b using the fixed effect model and the random effect model are shown in table 7. In contrast to model 3a, which regresses GPM on INTDAY, GDP, and LEV, model 3b regresses GPM on INTDAY, FSIZE, and LEV. Model 3a has 3569 observations, whereas model 3b has 3840. In both models 3a and 3b, whether using FEM or REM, the findings show that the primary independent variable INTDAY and the control variables (GDP, FSIZE, LEV) are statistically significant to the dependent variable GPM at the level of significance of 1% and 5%

Both the fixed effect model and the random effect model for model 3a provide the same results. They both show a negative correlation between the inventory days and the gross profit margin at the significant level of 1%, with beta values of -0.00114 and -0.00112, respectively. Hence, the firms' gross profit margin will increase by 0.00114 unit (for FEM) and 0.00112 unit (for REM) if the inventory days decrease by one unit while all other variables stay the same. With beta values of -1.039 and -0.877 at the 5% significant level, respectively, the GDP growth rate also negatively influences GPM when employing FEM and REM to regress. With coefficients of 0.0185 and 0.0220, respectively, the LEV variable significantly influences GPM when employing FEM at a level of 5%, and when using REM at a level of 1%. Using FEM, the R square is 0.047, indicating that only 4.7% of the fluctuations in the GPM variable can be explained by the INTDAY variable and the control variables. Our model has no multicollinearity, as evidenced by the VIF coefficients of each variable being less than 10 in both cases. The Hausman test is used to assess which regression model, FEM or REM, is more appropriate to analyze the relationship between the variables. The Hausman test results show that FEM is appropriate to regress model 3a, with a p-value of 0.0010. When we use FEM and test for autocorrelation, the p-value is 0.0682 (6.82%), which is greater than 5%, showing that our model does not have any autocorrelation.

Model 3b indicates that there is a negative relationship between profitability as measured by the gross profit margin and the inventory holding duration. The beta coefficient of INTDAY is -0.00114 (for FEM) and -0.00112 (for REM) at the 1% level of significance, correspondingly. This indicates that when INTDAY varies by one unit, GPM changes by -0.00114 unit and -0.00112 unit, respectively, if all other variables stay constant. The correlation between the FSIZE and GPM is positive at 1% significant level, with beta value of 1.318 for FEM and beta value of 1.293 for REM. With a beta coefficient of 0.0193 for the FEM and 0.0210 for the REM, both at 1% significant

level, the LEV variable exhibits a statistically significant positive relationship with the GPM variable in both cases. The VIF coefficient being less than 10 similar to model 3a shows that our model 3b does not have a multicollinearity problem. The Hausman test's p-value of 0.8316 suggests that utilizing REM to analyze model 3b is more appropriate. The p-value of the autocorrelation test is 0.0291 (2.91%), less than 5%, indicating that model 3b has an autocorrelation problem. After multicollinearity adjustment, the results in models 3a and 3b are similar to those in model 3 before multicollinearity adjustment. Whether utilizing FEM or REM, this relationship between the inventory days and firm's profitability is adverse and statistically significant at 1%. This shows that the result is trustworthy and straightforward. This relationship shows that, shorter the inventory holding period enhanced the Vietnamese company's earnings.

5.3.2.4. Effect of cash conversion cycle on profitability

$$\text{Model 4a: } \text{GPM}_{i,t} = \beta_0 + \beta_1 * \text{CCC}_{i,t} + \beta_2 * \text{GDP}_{i,t} + \beta_3 * \text{LEV}_{i,t} + \varepsilon_{i,t}$$

$$\text{Model 4b: } \text{GPM}_{i,t} = \beta_0 + \beta_1 * \text{CCC}_{i,t} + \beta_2 * \text{FSIZE}_{i,t} + \beta_3 * \text{LEV}_{i,t} + \varepsilon_{i,t}$$

Variable	Model 4a				Model 4b			
	FEM		REM		FEM		REM	
GPM	β	VIF	β	VIF	β	VIF	β	VIF
CCC	-0.00119*** [-11.87]	1.00	-0.00119*** [-12.22]	1.00	-0.00119*** [-11.96]	1.01	-0.00118*** [-12.32]	1.01
GDP	-1.052** [-2.37]	1.22	-0.890** [-2.01]	1.22				
FSIZE					1.399*** [2.84]	1.26	1.331*** [3.61]	1.26
LEV	0.0192** [2.55]	1.22	0.0225*** [3.28]	1.22	0.0197*** [2.75]	1.26	0.0213*** [3.21]	1.26
Constant	29.77*** [10.34]		28.08*** [9.49]		4.175 [0.63]		4.453 [0.89]	
N	3569		3569		3840		3840	
R-sq	0.048				0.046			
P-value (Hausman)	0.0018				0.9356			
P-value (Autocorrelation)	0.0592						0.0276	

Table 8. Regression results for model 4a and model 4b.

T-statistics in brackets.

*, **, and *** indicate $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively.

Table 8 displays the results of the regression for two models 4a and 4b using the fixed effect model and the random effect model, respectively. Model 4b regresses GPM on INTDAY, FSIZE, and LEV as opposed to model 4a's regressions of GPM on INTDAY, GDP, and LEV. The findings are obtained from 3569 observations from model 4a and 3840 observations from model 4b. The results reveal that the major independent variable CCC and the control variables (GDP, FSIZE, LEV) are statistically significant to the dependent variable GPM at the level of significance of 1% and 5% in both models 4a and 4b, whether employing FEM or REM.

For model 4a, the outcomes are the same for the fixed effect model and the random effect model. They both demonstrate a 1% significant negative correlation between the cash cycle and the gross profit margin, with beta values of -0.00119. As a result, if cash conversion cycle reduces by one unit while all other variables remain constant, the firm's gross profit margin will improve by 0.00119 unit (for both FEM and REM). When using FEM and REM, the GDP growth rate has beta values of -1.052 and -0.890 at the 5% significant level, respectively, indicating a negative relationship with GPM. The effect of the LEV variable on the GPM variable is statistically significant at 5% when utilizing FEM and at 1% when utilizing REM, with coefficients of 0.0192 and 0.0225, respectively. Using FEM, the R square is 0.048, suggesting that the CCC variable and the control variables explain just 4.8% of the variation in the GPM variable. Model 4a shows no multicollinearity, as proven by the fact that the VIF coefficients for each variable are less than 10 in both scenarios. Once again, the Hausman test is used to determine if the FEM or REM regression model is more suited to analyzing the connection between the variables. With a p-value of 0.0018, the Hausman test findings tell us that FEM is suitable for regressing model 4a. The p-value for autocorrelation test is 0.0592 (5.92%), which is larger than 5%, indicating that model 4a has no autocorrelation.

The cash conversion cycle and profitability as determined by the gross profit margin have a negative connection, as shown by the results of model 4b. For FEM and REM, respectively, the beta coefficient of CCC is -0.00119 and -0.00118 at the 1% level of significance. This implies that if all other factors remain constant, while CCC varies by one unit, GPM changes by -0.00119 unit and -0.00118 unit, correspondingly. With beta values of 1.399 for the FEM and 1.331 for the REM, the correlation between the FSIZE and GPM is significant at 1% level and is positive. The LEV variable has a statistically significant positive association with the GPM variable in both cases,

with a beta value of 0.0197 for the FEM and 0.0213 for the REM at the 1% significant level. The same with model 4a, the VIF coefficient being less than 10 demonstrates that our model 4b does not have a multicollinearity issue. The Hausman test's p-value of 0.9356 indicates that it is more reasonable to examine model 4b using REM. Model 4b has an autocorrelation issue, as indicated by the autocorrelation test's p-value of 0.0291 (2.91%), which is less than 5%. The outcomes in models 4a and 4b with multicollinearity adjustment are equivalent to those in model 4 prior to multicollinearity adjustment. This relationship between cash conversion period and firm's profitability is negative and statistically significant at 1%, regardless of whether FEM or REM is used. And it also reveals that reducing the cash conversion period increased the Vietnamese company's profitability.

5.4. Discussion and strategy recommendation

This study's main purpose is to identify the key factors of working capital management and to assess their significant impact on the profitability of the Vietnamese listed firms. Our empirical research has yielded some noteworthy findings. Firstly, all of the working capital management efficiency ratios – the primary independent variables (AR_{DAY}, AP_{DAY}, INT_{DAY}, CCC), are negatively correlated to the dependent variable - firm's profitability as measured by the gross profit margin. As regards the control variables, only the GDP growth rate (GDP) have the negative relationship to the firms' profitability while the other two variables, firm's leverage (LEV) and firms' size (FSIZE), are positively impact the firm's profitability.

Our study points out that the receivables collection period is negatively related to the profitability and this result is consistent with the study of Li (2016), Aldubhani, Wang, Gong, & Maudhah (2022), Hayajneh & Yassine (2011), Nguyen, Pham, & Nguyen (2020), Nguyen & Dang (2020). The Vietnamese firms can enhance profit when they shorten the credit term offered to their customers. Because when they offer long credit terms, they will not have the sufficient amount of capital to develop new projects, increase opportunity cost and probability of bad debt. However, the credit terms should be maintained at an acceptable level, to ensure satisfying the stakeholders. By doing that, firms need to carefully assess the creditworthiness through of the customers to grant the appropriate credit term to each customer. To evaluate customers' credit rating, firms can check to various sources, such as bank references. Secondly, companies must build up a collection policy

by making an aging report to easily check and follow up each receivable amount from each customer, to reduce the chance of incurring bad debt.

The relationship between the accounts payable period and the profitability is also negative. Our result is comparable to the study of Hayajneh & Yassine (2011), Nguyen, Pham, & Nguyen (2020). Nguyen & Dang (2020). This implies that Vietnamese firms would increase their profit when they settle their current debt with vendors as soon as possible. By quickly clearing off the outstanding current liabilities, the firms would be able to maintain goodwill with their suppliers, thus they can frequently purchase goods and materials from those vendors, reducing the chance of understocking. Moreover, they can enjoy the cash discount for early settlement of accounts payables. Carefully determining the cost associated with maximum use of trade credit is necessary for firms. By estimating the cost of lost cash discount, firms will have more motivation in quickly repaying the debt to enjoy higher rate of settlement discount. Nevertheless, firms will be under pressure to maintain the amount of cash on hand needed to sustain such a rate of repayment.

The inventory turnover period is negatively correlated with the firms' profitability, as shown in table 7. The outcomes are in line with the research of Hayajneh & Yassine (2011), Nguyen, Pham, & Nguyen (2020), Nguyen & Dang (2020). This result indicates that the Vietnamese firms should reduce the storage time in order to generate more profit. As storage time is decreased, the carrying cost of inventory is minimized. Moreover, as the rotation of inventory is improved, the product quality is also guaranteed because the risk of obsolescence is well managed, firms have more opportunity to seek for more customers and sign more new contracts, thus generate more revenue. For trading companies, they can adopt one technique is that placing their purchase quantity equal to the economic order quantity. By that, they can optimize the inventory related costs. For the manufacturing firms, they can apply just-in-time (JIT) method. With JIT technique, they could match their production process exactly with customers demand, improving productivity. More specifically, to build up an effective JIT system, firms must build up good relationships with their customers and vendors. By that, firms could obtain the forecasted demand data from the customers side, then match it directly with the inventory holding/production levels. And firms also need to manage a strong supply chain with qualified vendors, in order to make sure that there will be no delay in supplies delivery or poor-quality goods. In addition, the firms' warehouses need to be well organized, that is the goods and merchandise must be arranged neatly and orderly. So that it is

convenient to import and export goods when needed. When sales are quickly generated and the cost is well managed, the profitability of companies would be higher and stabilized.

The cash conversion cycle is proved to have a statistically significant and negative relationship with the firms' gross profit margin. This finding is also similar to the research of Shaik (2021), Aldubhani, Wang, Gong, & Maudhah (2022), Hayajneh & Yassine (2011), Nguyen, Pham, & Nguyen (2020), Nguyen & Dang (2020), Ukaegbu (2014). Because the cash conversion cycle is a combination of inventory period, accounts receivable and accounts payable period, such findings give us insight on how to formulate an appropriate working capital strategy in order to enhance profitability as well as maintain liquidity, and thus the firm performance is better off. With short cash cycle, the period from the moment cash is paid out for inventory to the collection of receivables is optimized. Quickly collecting cash would bring more opportunity because not only will the firms have more cash to invest in new projects and expanding the business, but their operational sustainability would be also guaranteed. Furthermore, firms can utilize Miller-Orr model in order to determine the optimal levels of cash holdings.

With the above findings, this study recommends that the Vietnamese listed firms should apply the moderate approach for both working capital investment policy and working capital financing policy. For the working capital investment, neither relaxed approach or restricted approach is appropriate. Because the relaxed approach requires high current asset and low current liabilities but our empirical results reveal that the profitability of firms would increase when holding small amount of current asset (as indicated by shortening accounts receivable period and inventory period). And the restricted approach would require to maintain low current asset and high current liabilities while this study points out keeping low level of current debt would improve firms' profitability (as indicated by reducing accounts payable period). Therefore, the best appropriate is to utilize the moderate strategy to calculate and manage well a proper amount of working capital. As regard to financing working capital, firms should use moderate (maturity matching) financing policy to reduce the risk of insolvency. The business should make an effort to align the borrowing and payment terms with the changes in the current asset. By such ways, Vietnamese listed firms would be able to increase profit and maintain liquidity, and therefore improve firm's performance and sustainability against crisis.

6. Conclusion

Working capital has been playing an important role as one of the main finance sources for the companies to sustain and develop. The aim of this study is to investigate the impact of working capital management, as measured by working capital efficiency, on the profitability of Vietnamese companies. The study employs an unbalanced data set from the annual financial statements of 604 listed firms from 2001 to 2019. Using descriptive statistic, Pearson correlation analysis, and multiple regression analysis with fixed effect combine with random effect model, our empirical study has pointed out that the working capital efficiency, which consist of accounts receivable days, accounts payable days, inventory days as well as cash conversion cycle, all have a statistically significant and negative relationship with the firms' profitability as measured by the gross profit margin.

Our research indicates that Vietnamese businesses ought to reduce the period of storage in order to increase profits. To do that, firms should apply EOQ model or JIT process to manage inventory more efficiently, reducing the holding costs and avoiding product loss, damage or obsolescence. The findings also imply that firms could increase profitability by trying to collect accounts receivable rapidly and applying appropriate credit terms to customers. Hence, they could frequently maintain enough resources to fund new projects, reduce opportunity costs as well as avoid bad debts incurred. In addition, the payable amount should also be well managed as the companies' profit could be better off when firms pay their debt on times. Firms should carefully assess the cost of loss cash discount to check whether they should optimize their use of trade credit from suppliers. The study results support that firms should clear-off the current debts with vendors to benefit from high cash discount rate. And yet, maintaining such a high rate of repayment is undoubtedly placing great strain on businesses. Thus, they should use Miller-Orr model to estimate the ideal cash holdings level to avoid illiquidity. Furthermore, the findings suggest the cash conversion cycle needs to be shorten for better management of cashflows, and therefore, firms could control the cashflows effectively to develop business, increase profitability as well as sustainability against economic downturn. Our research also recommends the finance managers of Vietnamese firms to apply the moderate approach for both working capital investment and financing strategy.

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Vietnamese-German University

Appendices

I. BEFORE ADJUSTMENT FOR MULTICOLLINEARITY

1. FEM

Regression results and multicollinearity test

Model 1: $GPM_{i,t} = \beta_0 + \beta_1 \cdot ARDAY_{i,t} + \beta_2 \cdot GDP_{i,t} + \beta_3 \cdot LEV_{i,t} + \beta_4 \cdot FSIZE_{i,t} + \varepsilon_{i,t}$

. xtreg GPM ARDAY GDP FIRMSIZE LEVERAGE, fe

```
Fixed-effects (within) regression      Number of obs   =   3,568
Group variable: firmid                 Number of groups =    501

R-squared:                               Obs per group:
  Within = 0.0156                        min =          1
  Between = 0.0158                       avg =         7.1
  Overall = 0.0148                       max =          9

corr(u_i, Xb) = -0.0225                  F(4, 3063)      =   12.13
                                          Prob > F        =   0.0000
```

GPM	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
ARDAY	-.0051498	.0009907	-5.20	0.000	-.0070923	-.0032074
GDP	-1.481896	.4805272	-3.08	0.002	-2.424085	-.539708
FIRMSIZE	1.569182	.5715942	2.75	0.006	.4484348	2.689929
LEVERAGE	.0130307	.0078248	1.67	0.096	-.0023117	.0283732
_cons	11.7391	7.336423	1.60	0.110	-2.645708	26.12391
sigma_u	18.363758					
sigma_e	14.974993					
rho	.60060696	(fraction of variance due to u_i)				

F test that all u_i=0: F(500, 3063) = 10.15 Prob > F = 0.0000

. vif, uncentered

Variable	VIF	1/VIF
FIRMSIZE	56.84	0.017594
GDP	55.25	0.018098
LEVERAGE	1.30	0.766871
ARDAY	1.08	0.929833
Mean VIF	28.62	

$$\text{Model 2: } \text{GPM}_{i,t} = \beta_0 + \beta_1 * \text{APDAY}_{i,t} + \beta_2 * \text{GDP}_{i,t} + \beta_3 * \text{LEV}_{i,t} + \beta_4 * \text{FSIZE}_{i,t} + \varepsilon_{i,t}$$

. xtreg GPM APDAY GDP FIRMSIZE LEVERAGE, fe

```

Fixed-effects (within) regression           Number of obs   =       3,566
Group variable: firmid                     Number of groups =        501

R-squared:                                 Obs per group:
  Within = 0.0112                          min =           1
  Between = 0.0167                         avg =           7.1
  Overall = 0.0114                          max =           9

corr(u_i, Xb) = -0.0652                    F(4, 3061)      =        8.64
                                           Prob > F        =       0.0000

```

GPM	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
APDAY	-.0012052	.000421	-2.86	0.004	-.0020306	-.0003798
GDP	-1.570547	.4779406	-3.29	0.001	-2.507664	-.63343
FIRMSIZE	2.035506	.5745132	3.54	0.000	.909035	3.161976
LEVERAGE	.0137032	.0077687	1.76	0.078	-.0015291	.0289355
_cons	5.676033	7.362233	0.77	0.441	-8.759387	20.11145
sigma_u	18.385138					
sigma_e	14.874277					
rho	.60439665	Vietnamese-German University (fraction of variance due to u_i)				

F test that all u_i=0: F(500, 3061) = 10.33 Prob > F = 0.0000

. vif, uncentered

Variable	VIF	1/VIF
FIRMSIZE	56.89	0.017576
GDP	55.22	0.018109
LEVERAGE	1.30	0.766703
APDAY	1.02	0.978882
Mean VIF	28.61	

$$\text{Model 3: } \text{GPM}_{i,t} = \beta_0 + \beta_1 * \text{INTDAY}_{i,t} + \beta_2 * \text{GDP}_{i,t} + \beta_3 * \text{LEV}_{i,t} + \beta_4 * \text{FSIZE}_{i,t} + \varepsilon_{i,t}$$

. xtreg GPM INTDAY GDP FIRMSIZE LEVERAGE, fe

```

Fixed-effects (within) regression      Number of obs   =   3,566
Group variable: firmid                Number of groups =   501

R-squared:                             Obs per group:
    Within = 0.0510                    min =          1
    Between = 0.0298                   avg =          7.1
    Overall = 0.0283                    max =          9

corr(u_i, Xb) = -0.0644                F(4,3061)       =   41.11
                                         Prob > F        =   0.0000

```

GPM	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
INTDAY	-.0011413	.0000975	-11.70	0.000	-.0013325	-.0009501
GDP	-1.583503	.4677409	-3.39	0.001	-2.500621	-.6663848
FIRMSIZE	2.093831	.5615382	3.73	0.000	.9928009	3.194861
LEVERAGE	.0141185	.0076001	1.86	0.063	-.0007834	.0290203
_cons	5.084892	7.199702	0.71	0.480	-9.031846	19.20163
sigma_u	18.283917					
sigma_e	14.571725					
rho	.6115608					

F test that all u_i=0: F(500, 3061) = 10.72 Prob > F = 0.0000

. vif, uncentered

Variable	VIF	1/VIF
FIRMSIZE	56.93	0.017567
GDP	55.22	0.018109
LEVERAGE	1.30	0.766819
INTDAY	1.01	0.994470
Mean VIF	28.61	

$$\text{Model 4: } \text{GPM}_{i,t} = \beta_0 + \beta_1 * \text{CCC}_{i,t} + \beta_2 * \text{GDP}_{i,t} + \beta_3 * \text{LEV}_{i,t} + \beta_4 * \text{FSIZE}_{i,t} + \varepsilon_{i,t}$$

. xtreg GPM CCC GDP FIRMSIZE LEVERAGE, fe

```

Fixed-effects (within) regression      Number of obs   =    3,566
Group variable: firmid                Number of groups =    501

R-squared:                             Obs per group:
  Within = 0.0525                       min =          1
  Between = 0.0299                       avg =         7.1
  Overall = 0.0294                       max =          9

corr(u_i, Xb) = -0.0630                 F(4,3061)       =    42.37
                                          Prob > F        =    0.0000

```

GPM	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
CCC	-.0011966	.0001004	-11.92	0.000	-.0013935	-.0009997
GDP	-1.618171	.467358	-3.46	0.001	-2.534538	-.7018036
FIRMSIZE	2.178199	.561087	3.88	0.000	1.078054	3.278344
LEVERAGE	.0146551	.0075939	1.93	0.054	-.0002346	.0295448
_cons	4.134733	7.193888	0.57	0.565	-9.970605	18.24007
sigma_u	18.275424					
sigma_e	14.560348					
rho	.61171111					

F test that all u_i=0: F(500, 3061) = 10.72 Prob > F = 0.0000

. vif, uncentered

Variable	VIF	1/VIF
FIRMSIZE	56.93	0.017566
GDP	55.22	0.018109
LEVERAGE	1.30	0.766764
CCC	1.01	0.994994
Mean VIF	28.61	

2. REM

Regression results and multicollinearity test

$$\text{Model 1: } \text{GPM}_{i,t} = \beta_0 + \beta_1 \cdot \text{ARDAY}_{i,t} + \beta_2 \cdot \text{GDP}_{i,t} + \beta_3 \cdot \text{LEV}_{i,t} + \beta_4 \cdot \text{FSIZE}_{i,t} + \varepsilon_{i,t}$$

. xtreg GPM ARDAY GDP FIRMSIZE LEVERAGE, re

```

Random-effects GLS regression           Number of obs   =       3,568
Group variable: firmid                 Number of groups =        501

R-squared:                             Obs per group:
  Within = 0.0154                       min =          1
  Between = 0.0177                       avg =          7.1
  Overall = 0.0161                       max =          9

corr(u_i, X) = 0 (assumed)              Wald chi2(4)    =       56.93
                                          Prob > chi2     =       0.0000
  
```

GPM	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
ARDAY	-.0053508	.000978	-5.47	0.000	-.0072677	-.003434
GDP	-1.242639	.467171	-2.66	0.008	-2.158277	-.3270008
FIRMSIZE	1.321161	.401808	3.29	0.001	.5336314	2.10869
LEVERAGE	.0160842	.0071312	2.26	0.024	.0021073	.030061
_cons	12.96534	5.558108	2.33	0.020	2.071652	23.85903
sigma_u	17.024505					
sigma_e	14.974993					
rho	.56378658 (fraction of variance due to u_i)					

. vif, uncentered

Variable	VIF	1/VIF
FIRMSIZE	56.84	0.017594
GDP	55.25	0.018098
LEVERAGE	1.30	0.766871
ARDAY	1.08	0.929833
Mean VIF	28.62	

$$\text{Model 2: } \text{GPM}_{i,t} = \beta_0 + \beta_1 \cdot \text{APDAY}_{i,t} + \beta_2 \cdot \text{GDP}_{i,t} + \beta_3 \cdot \text{LEV}_{i,t} + \beta_4 \cdot \text{FSIZE}_{i,t} + \varepsilon_{i,t}$$

. xtreg GPM APDAY GDP FIRMSIZE LEVERAGE, re

```

Random-effects GLS regression           Number of obs   =       3,566
Group variable: firmid                 Number of groups =        501

R-squared:                             Obs per group:
  Within = 0.0108                       min =          1
  Between = 0.0197                      avg =         7.1
  Overall = 0.0128                      max =          9

corr(u_i, X) = 0 (assumed)              Wald chi2(4)    =       42.98
                                         Prob > chi2     =       0.0000

```

GPM	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
APDAY	-.0014021	.0004064	-3.45	0.001	-.0021987	-.0006056
GDP	-1.27605	.4644436	-2.75	0.006	-2.186343	-.3657578
FIRMSIZE	1.560591	.4024256	3.88	0.000	.7718516	2.349331
LEVERAGE	.0165357	.007089	2.33	0.020	.0026415	.0304298
_cons	9.63581	5.556682	1.73	0.083	-1.255087	20.52671
sigma_u	17.005843					
sigma_e	14.874277					
rho	.56656434	Vietnamese-German University (fraction of variance due to u_i)				

. vif, uncentered

Variable	VIF	1/VIF
FIRMSIZE	56.89	0.017576
GDP	55.22	0.018109
LEVERAGE	1.30	0.766703
APDAY	1.02	0.978882
Mean VIF	28.61	

$$\text{Model 3: } \text{GPM}_{i,t} = \beta_0 + \beta_1 * \text{INTDAY}_{i,t} + \beta_2 * \text{GDP}_{i,t} + \beta_3 * \text{LEV}_{i,t} + \beta_4 * \text{FSIZE}_{i,t} + \varepsilon_{i,t}$$

. xtreg GPM INTDAY GDP FIRMSIZE LEVERAGE, re

```

Random-effects GLS regression           Number of obs   =       3,566
Group variable: firmid                 Number of groups =        501

R-squared:                               Obs per group:
    Within = 0.0508                       min =           1
    Between = 0.0311                      avg =           7.1
    Overall = 0.0298                      max =           9

corr(u_i, X) = 0 (assumed)              Wald chi2(4)    =       177.31
                                         Prob > chi2     =        0.0000

```

GPM	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
INTDAY	-.0011237	.0000933	-12.05	0.000	-.0013066	-.0009409
GDP	-1.316592	.4548465	-2.89	0.004	-2.208074	-.4251088
FIRMSIZE	1.633903	.397681	4.11	0.000	.8544627	2.413344
LEVERAGE	.0166412	.0069579	2.39	0.017	.0030039	.0302784
_cons	9.052525	5.480488	1.65	0.099	-1.689035	19.79409
sigma_u	17.026247					
sigma_e	14.571725					
rho	.57721384					

. vif, uncentered

Variable	VIF	1/VIF
FIRMSIZE	56.93	0.017567
GDP	55.22	0.018109
LEVERAGE	1.30	0.766819
INTDAY	1.01	0.994470
Mean VIF	28.61	

$$\text{Model 4: } \text{GPM}_{i,t} = \beta_0 + \beta_1 * \text{CCC}_{i,t} + \beta_2 * \text{GDP}_{i,t} + \beta_3 * \text{LEV}_{i,t} + \beta_4 * \text{FSIZE}_{i,t} + \varepsilon_{i,t}$$

. xtreg GPM CCC GDP FIRMSIZE LEVERAGE, re

```

Random-effects GLS regression           Number of obs   =       3,566
Group variable: firmid                 Number of groups =        501

R-squared:                             Obs per group:
  Within = 0.0522                       min =           1
  Between = 0.0319                      avg =           7.1
  Overall = 0.0314                      max =           9

corr(u_i, X) = 0 (assumed)              Wald chi2(4)    =       183.12
                                          Prob > chi2     =       0.0000

```

GPM	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
CCC	-.0011931	.0000971	-12.28	0.000	-.0013835	-.0010028
GDP	-1.338392	.4544695	-2.94	0.003	-2.229136	-.4476481
FIRMSIZE	1.666942	.3974509	4.19	0.000	.8879523	2.445931
LEVERAGE	.0170126	.0069523	2.45	0.014	.0033862	.0306389
_cons	8.714316	5.476888	1.59	0.112	-2.020187	19.44882
sigma_u	17.021221					
sigma_e	14.560348					
rho	.57745092	Vietnamese-German University (fraction of variance due to u_i)				

. vif, uncentered

Variable	VIF	1/VIF
FIRMSIZE	56.93	0.017566
GDP	55.22	0.018109
LEVERAGE	1.30	0.766764
CCC	1.01	0.994994
Mean VIF	28.61	

II. AFTER ADJUSTMENT FOR MULTICOLLINEARITY

1. Model 1a and model 1b

Model 1a: $GPM_{i,t} = \beta_0 + \beta_1 \cdot ARDAY_{i,t} + \beta_2 \cdot GDP_{i,t} + \beta_3 \cdot LEV_{i,t} + \varepsilon_{i,t}$

✚ Regression results and multicollinearity test

❖ FEM

```
. xtreg GPM ARDAY GDP LEVERAGE, fe
```

```
Fixed-effects (within) regression      Number of obs   =      3,571
Group variable: firmid                 Number of groups =       501

R-squared:                               Obs per group:
  Within = 0.0132                          min =          1
  Between = 0.0111                         avg =         7.1
  Overall = 0.0117                          max =          9

corr(u_i, Xb) = 0.0319                    F(3,3067)       =      13.73
                                           Prob > F        =      0.0000
```

GPM	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
ARDAY	-.0052488	.000991	-5.30	0.000	-.0071918	-.0033058
GDP	-1.07332	.4566782	-2.35	0.019	-1.968746	-.1778938
LEVERAGE	.0163279	.0077428	2.11	0.035	.0011463	.0315094
_cons	30.20084	2.954196	10.22	0.000	24.40844	35.99325
sigma_u	18.422183					
sigma_e	14.989182					
rho	.60167605 (fraction of variance due to u_i)					

```
F test that all u_i=0: F(500, 3067) = 10.18      Prob > F = 0.0000
```

```
. est sto AR_fe1
```

```
. vif, uncentered
```

Variable	VIF	1/VIF
GDP	1.29	0.773024
LEVERAGE	1.22	0.820772
ARDAY	1.08	0.929933
Mean VIF	1.20	

❖ **REM**

. xtreg GPM ARDAY GDP LEVERAGE, re

```

Random-effects GLS regression           Number of obs   =       3,571
Group variable: firmid                 Number of groups =        501

R-squared:                               Obs per group:
    Within = 0.0131                       min =           1
    Between = 0.0132                      avg =           7.1
    Overall = 0.0128                      max =           9

corr(u_i, X) = 0 (assumed)              Wald chi2(3)    =       46.25
                                          Prob > chi2     =       0.0000
  
```

GPM	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
ARDAY	-.0054194	.0009789	-5.54	0.000	-.0073381	-.0035007
GDP	-.8854934	.4546385	-1.95	0.051	-1.776569	.0055818
LEVERAGE	.0204971	.0070155	2.92	0.003	.0067469	.0342473
_cons	28.30394	3.033426	9.33	0.000	22.35854	34.24935
sigma_u	17.038203					
sigma_e	14.989182					
rho	.56371637					


 (fraction of variance due to u_i)
 Vietnamese-German University

. est sto AR_re1

. vif, uncentered

Variable	VIF	1/VIF
GDP	1.29	0.773024
LEVERAGE	1.22	0.820772
ARDAY	1.08	0.929933
Mean VIF	1.20	

 **Hausman test FEM vs REM**

. hausman AR_fe1 AR_re1

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
	(b) AR_fe1	(B) AR_re1		
ARDAY	-.0052488	-.0054194	.0001706	.0001538
GDP	-1.07332	-.8854934	-.1878265	.0431133
LEVERAGE	.0163279	.0204971	-.0041693	.0032761

b = Consistent under H0 and Ha; obtained from xtreg.
 B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
 = 20.44
 Prob > chi2 = 0.0001

 **Wooldridge test for autocorrelation**

. xtserial GPM ARDAY GDP LEVERAGE

Wooldridge test for autocorrelation in panel data
 H0: no first-order autocorrelation
 F(1, 470) = 2.910
 Prob > F = 0.0887

$$\text{Model 1b: } \text{GPM}_{i,t} = \beta_0 + \beta_1 * \text{ARDAY}_{i,t} + \beta_2 * \text{FSIZE}_{i,t} + \beta_3 * \text{LEV}_{i,t} + \varepsilon_{i,t}$$

Regression results and multicollinearity test

❖ FEM

`. xtreg GPM ARDAY FIRMSIZE LEVERAGE, fe`

```
Fixed-effects (within) regression      Number of obs   =    3,842
Group variable: firmid                 Number of groups =     501

R-squared:                               Obs per group:
  Within = 0.0073                        min =          1
  Between = 0.0234                       avg =          7.7
  Overall = 0.0161                       max =          11

corr(u_i, Xb) = 0.0379                  F(3, 3338)      =     8.17
                                          Prob > F        =    0.0000
```

GPM	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
ARDAY	-.0028379	.0008312	-3.41	0.001	-.0044676	-.0012082
FIRMSIZE	.910683	.5016019	1.82	0.070	-.0727952	1.894161
LEVERAGE	.0192784	.007387	2.61	0.009	.0047949	.0337618
_cons	10.8527	6.780735	1.60	0.110	-2.442119	24.14751
sigma_u	18.277678	Vietnamese-German University				
sigma_e	14.886159					
rho	.60120714	(fraction of variance due to u_i)				

F test that all u_i=0: F(500, 3338) = 11.02 Prob > F = 0.0000

`. est sto AR_fe2`

`. vif, uncentered`

Variable	VIF	1/VIF
FIRMSIZE	1.32	0.758311
LEVERAGE	1.26	0.796297
ARDAY	1.06	0.942138
Mean VIF	1.21	

❖ REM

. xtreg GPM ARDAY FIRMSIZE LEVERAGE, re


```

Random-effects GLS regression           Number of obs   =   3,842
Group variable: firmid                 Number of groups =    501

R-squared:                             Obs per group:
    Within = 0.0073                      min =          1
    Between = 0.0232                     avg =          7.7
    Overall = 0.0161                      max =         11

corr(u_i, X) = 0 (assumed)              Wald chi2(3)    =   35.34
                                          Prob > chi2     =   0.0000
  
```

GPM	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
ARDAY	-.0029948	.0008216	-3.64	0.000	-.0046052	-.0013844
FIRMSIZE	1.027807	.373829	2.75	0.006	.2951154	1.760498
LEVERAGE	.0212249	.0068158	3.11	0.002	.0078661	.0345837
_cons	8.54818	5.071743	1.69	0.092	-1.392253	18.48861
sigma_u	17.208962					
sigma_e	14.886159					
rho	.57199537					


 (fraction of variance due to u_i)
 Vietnamese-German University

. est sto AR_re2

. vif, uncentered

Variable	VIF	1/VIF
FIRMSIZE	1.32	0.758311
LEVERAGE	1.26	0.796297
ARDAY	1.06	0.942138
Mean VIF	1.21	

 **Hausman test FEM vs REM**

. hausman AR_fe2 AR_re2

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
	(b) AR_fe2	(B) AR_re2		
ARDAY	-.0028379	-.0029948	.0001569	.0001256
FIRMSIZE	.910683	1.027807	-.1171238	.3344492
LEVERAGE	.0192784	.0212249	-.0019466	.0028481

b = Consistent under H0 and Ha; obtained from xtreg.
 B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
 = 2.81
 Prob > chi2 = 0.4221

 **Wooldridge test for autocorrelation**

. xtserial GPM ARDAY FIRMSIZE LEVERAGE

Wooldridge test for autocorrelation in panel data
 H0: no first-order autocorrelation
 F(1, 472) = 4.405
 Prob > F = 0.0364

2. Model 2a and model 2b

Model 2a: $GPM_{i,t} = \beta_0 + \beta_1 * APDAY_{i,t} + \beta_2 * GDP_{i,t} + \beta_3 * LEV_{i,t} + \varepsilon_{i,t}$

Regression results and multicollinearity test

❖ FEM

```
. xtreg GPM APDAY GDP LEVERAGE, fe
```

```
Fixed-effects (within) regression          Number of obs   =       3,569
Group variable: firmid                    Number of groups =        501

R-squared:                                Obs per group:
  Within = 0.0072                          min =           1
  Between = 0.0147                         avg =           7.1
  Overall = 0.0078                          max =           9

corr(u_i, Xb) = 0.0270                     F(3, 3065)      =        7.38
                                           Prob > F        =       0.0001
```

	GPM	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
	APDAY	-.0013064	.0004207	-3.11	0.002	-.0021313	-.0004815
	GDP	-1.039095	.4540711	-2.29	0.022	-1.92941	-.1487806
	LEVERAGE	.0178449	.0076943	2.32	0.020	.0027584	.0329313
	_cons	29.62474	2.938262	10.08	0.000	23.86357	35.3859
	sigma_u	18.412007					
	sigma_e	14.900791					
	rho	.60424335	(fraction of variance due to u_i)				

F test that all u_i=0: F(500, 3065) = 10.34 Prob > F = 0.0000

```
. est sto AP_fe1
```

```
. vif, uncentered
```

Variable	VIF	1/VIF
GDP	1.24	0.807955
LEVERAGE	1.22	0.820481
APDAY	1.02	0.978912
Mean VIF	1.16	

❖ REM

. xtreg GPM APDAY GDP LEVERAGE, re

```


Random-effects GLS regression           Number of obs   =       3,569
Group variable: firmid                 Number of groups =        501

R-squared:                             Obs per group:
    Within = 0.0070                      min =           1
    Between = 0.0168                     avg =           7.1
    Overall = 0.0088                     max =           9

corr(u_i, X) = 0 (assumed)              Wald chi2(3)    =       28.03
                                          Prob > chi2     =       0.0000

```

GPM	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
APDAY	-.0014563	.0004069	-3.58	0.000	-.0022539	-.0006587
GDP	-.8541765	.4521271	-1.89	0.059	-1.740329	.0319765
LEVERAGE	.0216761	.0069784	3.11	0.002	.0079987	.0353535
_cons	27.75858	3.018575	9.20	0.000	21.84228	33.67488
sigma_u	17.02688					
sigma_e	14.900791					
rho	.56629684					


 (fraction of variance due to u_i)
 Vietnamese-German University

. est sto AP_re1

. vif, uncentered

Variable	VIF	1/VIF
GDP	1.24	0.807955
LEVERAGE	1.22	0.820481
APDAY	1.02	0.978912
Mean VIF	1.16	

✚ Hausman test FEM vs REM

. hausman AP_fe1 AP_re1

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
	(b) AP_fe1	(B) AP_re1		
APDAY	-.0013064	-.0014563	.0001499	.0001068
GDP	-1.039095	-.8541765	-.1849186	.041971
LEVERAGE	.0178449	.0216761	-.0038313	.0032409

b = Consistent under H0 and Ha; obtained from xtreg.
 B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
 = 21.07
 Prob > chi2 = 0.0001

✚ Wooldridge test for autocorrelation

. xtserial GPM APDAY GDP LEVERAGE

Wooldridge test for autocorrelation in panel data
 H0: no first-order autocorrelation
 F(1, 470) = 3.228
 Prob > F = 0.0731

$$\text{Model 2b: } \text{GPM}_{i,t} = \beta_0 + \beta_1 * \text{APDAY}_{i,t} + \beta_2 * \text{FSIZE}_{i,t} + \beta_3 * \text{LEV}_{i,t} + \varepsilon_{i,t}$$

Regression results and multicollinearity test

❖ FEM

. xtreg GPM APDAY FIRMSIZE LEVERAGE, fe

```

Fixed-effects (within) regression           Number of obs   =       3,840
Group variable: firmid                    Number of groups =        501

R-squared:                                Obs per group:
  Within = 0.0066                          min =           1
  Between = 0.0253                         avg =           7.7
  Overall = 0.0147                          max =           11

corr(u_i, Xb) = 0.0091                    F(3,3336)       =        7.38
                                           Prob > F        =       0.0001

```

GPM	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
APDAY	-.0009182	.0003996	-2.30	0.022	-.0017016	-.0001347
FIRMSIZE	1.270018	.5027465	2.53	0.012	.2842949	2.25574
LEVERAGE	.0192333	.0073231	2.63	0.009	.004875	.0335916
_cons	5.81038	6.799573	0.85	0.393	-7.521376	19.14214
Vietnamese-German University						
sigma_u	18.256053					
sigma_e	14.76211					
rho	.60464704	(fraction of variance due to u_i)				

F test that all u_i=0: F(500, 3336) = 11.23 Prob > F = 0.0000

. est sto AP_fe2

. vif, uncentered

Variable	VIF	1/VIF
FIRMSIZE	1.28	0.783744
LEVERAGE	1.26	0.796152
APDAY	1.02	0.978443
Mean VIF	1.18	

❖ REM

. xtreg GPM APDAY FIRMSIZE LEVERAGE, re


```

Random-effects GLS regression           Number of obs   =    3,840
Group variable: firmid                 Number of groups =    501

R-squared:                             Obs per group:
  Within = 0.0066                       min =          1
  Between = 0.0268                      avg =          7.7
  Overall = 0.0151                      max =          11

corr(u_i, X) = 0 (assumed)              Wald chi2(3)    =    34.53
                                          Prob > chi2     =    0.0000
  
```

GPM	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
APDAY	-.0011015	.0003865	-2.85	0.004	-.0018589	-.000344
FIRMSIZE	1.235225	.3737239	3.31	0.001	.5027399	1.967711
LEVERAGE	.0211093	.0067643	3.12	0.002	.0078516	.0343671
_cons	5.598074	5.071765	1.10	0.270	-4.342403	15.53855
sigma_u	17.16089					
sigma_e	14.76211					
rho	.5747208					



 (fraction of variance due to u_i)

 Vietnamese-German University

. est sto AP_re2

. vif, uncentered

Variable	VIF	1/VIF
FIRMSIZE	1.28	0.783744
LEVERAGE	1.26	0.796152
APDAY	1.02	0.978443
Mean VIF	1.18	

 **Hausman test FEM vs REM**


. hausman AP_fe2 AP_re2

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
	(b) AP_fe2	(B) AP_re2		
APDAY	-.0009182	-.0011015	.0001833	.0001015
FIRMSIZE	1.270018	1.235225	.0347923	.3362804
LEVERAGE	.0192333	.0211093	-.001876	.0028058

b = Consistent under H0 and Ha; obtained from xtreg.
 B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
 = 4.29
 Prob > chi2 = 0.2319

 **Wooldridge test for autocorrelation**

. xtserial GPM APDAY FIRMSIZE LEVERAGE

Wooldridge test for autocorrelation in panel data
 H0: no first-order autocorrelation
 F(1, 472) = 4.392
 Prob > F = 0.0366

3. Model 3a and model 3b

$$\text{Model 3a: } \text{GPM}_{i,t} = \beta_0 + \beta_1 \cdot \text{INTDAY}_{i,t} + \beta_2 \cdot \text{GDP}_{i,t} + \beta_3 \cdot \text{LEV}_{i,t} + \varepsilon_{i,t}$$

✚ Regression results and multicollinearity test

❖ FEM

```
. xtreg GPM INTDAY GDP LEVERAGE, fe
```

```
Fixed-effects (within) regression      Number of obs   =    3,569
Group variable: firmid                 Number of groups =     501

R-squared:                             Obs per group:
  Within = 0.0467                       min =          1
  Between = 0.0213                      avg =          7.1
  Overall = 0.0241                      max =          9

corr(u_i, Xb) = -0.0107                 F(3, 3065)      =    50.04
                                         Prob > F        =    0.0000
```

GPM	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
INTDAY	-.0011442	.0000977	-11.71	0.000	-.0013358	-.0009526
GDP	-1.039484	.4448028	-2.34	0.020	-1.911626	-.1673424
LEVERAGE	.0184934	.0075247	2.46	0.014	.0037394	.0332473
_cons	29.7236	2.87913	10.32	0.000	24.07838	35.36882
sigma_u	18.322498					
sigma_e	14.601183					
rho	.61160272	(fraction of variance due to u_i)				

```
F test that all u_i=0: F(500, 3065) = 10.73      Prob > F = 0.0000
```

```
. est sto INT_fe1
```

```
. vif, uncentered
```

Variable	VIF	1/VIF
GDP	1.22	0.817295
LEVERAGE	1.22	0.820684
INTDAY	1.00	0.995040
Mean VIF	1.15	

❖ **REM**

. xtreg GPM INTDAY GDP LEVERAGE, re


```

Random-effects GLS regression           Number of obs   =       3,569
Group variable: firmid                 Number of groups =        501

R-squared:                               Obs per group:
  Within = 0.0466                        min =          1
  Between = 0.0227                       avg =         7.1
  Overall = 0.0250                       max =          9

corr(u_i, X) = 0 (assumed)              Wald chi2(3)    =       159.91
                                          Prob > chi2     =       0.0000
  
```

GPM	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
INTDAY	-.0011225	.0000935	-12.01	0.000	-.0013057	-.0009392
GDP	-.876917	.4428014	-1.98	0.048	-1.744792	-.0090422
LEVERAGE	.0220042	.0068503	3.21	0.001	.0085778	.0354306
_cons	28.03276	2.961429	9.47	0.000	22.22846	33.83705
sigma_u	17.049742					
sigma_e	14.601183					
rho	.57690112					

 (fraction of variance due to u_i)
 Vietnamese-German University

. est sto INT_re1

. vif, uncentered

Variable	VIF	1/VIF
GDP	1.22	0.817295
LEVERAGE	1.22	0.820684
INTDAY	1.00	0.995040
Mean VIF	1.15	

 **Hausman test FEM vs REM**

. hausman INT_fe1 INT_re1

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
	(b) INT_fe1	(B) INT_re1		
INTDAY	-.0011442	-.0011225	-.0000217	.0000284
GDP	-1.039484	-.876917	-.1625673	.0421476
LEVERAGE	.0184934	.0220042	-.0035109	.0031135

b = Consistent under H0 and Ha; obtained from xtreg.
 B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
 = 16.34
 Prob > chi2 = 0.0010

 **Wooldridge test for autocorrelation**

. xtserial GPM INTDAY GDP LEVERAGE

Wooldridge test for autocorrelation in panel data
 H0: no first-order autocorrelation
 F(1, 470) = 3.342
 Prob > F = 0.0682

$$\text{Model 3b: } \text{GPM}_{i,t} = \beta_0 + \beta_1 * \text{INTDAY}_{i,t} + \beta_2 * \text{FSIZE}_{i,t} + \beta_3 * \text{LEV}_{i,t} + \varepsilon_{i,t}$$

Regression results and multicollinearity test

❖ FEM

. xtreg GPM INTDAY FIRMSIZE LEVERAGE, fe

```

Fixed-effects (within) regression           Number of obs   =       3,840
Group variable: firmid                     Number of groups =        501

R-squared:                                 Obs per group:
  Within = 0.0448                           min =           1
  Between = 0.0360                          avg =           7.7
  Overall = 0.0308                           max =          11

corr(u_i, Xb) = -0.0133                    F(3, 3336)      =       52.10
                                           Prob > F        =       0.0000
    
```

GPM	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
INTDAY	-.0011396	.0000967	-11.78	0.000	-.0013292	-.0009499
FIRMSIZE	1.318312	.49221	2.68	0.007	.3532481	2.283376
LEVERAGE	.0192817	.0071723	2.69	0.007	.0052191	.0333443
_cons	5.302923	6.653987	0.80	0.426	-7.743385	18.34923
Vietnamese-German University						
sigma_u	18.149103					
sigma_e	14.475799					
rho	.61118257	(fraction of variance due to u_i)				

F test that all u_i=0: F(500, 3336) = 11.64 Prob > F = 0.0000

. est sto INT_fe2

. vif, uncentered

Variable	VIF	1/VIF
FIRMSIZE	1.26	0.792552
LEVERAGE	1.26	0.796263
INTDAY	1.01	0.994395
Mean VIF	1.17	

❖ REM

. xtreg GPM INTDAY FIRMSIZE LEVERAGE, re

```

Random-effects GLS regression           Number of obs   =   3,840
Group variable: firmid                 Number of groups =    501

R-squared:                               Obs per group:
  Within = 0.0447                        min =          1
  Between = 0.0363                       avg =          7.7
  Overall = 0.0310                       max =          11

corr(u_i, X) = 0 (assumed)              Wald chi2(3)    =   173.70
                                          Prob > chi2     =    0.0000

```

GPM	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
INTDAY	-.0011203	.0000925	-12.11	0.000	-.0013017	-.0009389
FIRMSIZE	1.293293	.3690901	3.50	0.000	.5698901	2.016697
LEVERAGE	.0210125	.0066424	3.16	0.002	.0079937	.0340314
_cons	4.995183	5.008375	1.00	0.319	-4.821052	14.81142
sigma_u	17.172492					
sigma_e	14.475799					
rho	.58459397					

(fraction of variance due to u_i)

Vietnamese-German University

. est sto INT_re2

. vif, uncentered

Variable	VIF	1/VIF
FIRMSIZE	1.26	0.792552
LEVERAGE	1.26	0.796263
INTDAY	1.01	0.994395
Mean VIF	1.17	

 **Hausman test FEM vs REM**

. hausman INT_fe2 INT_re2

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
	(b) INT_fe2	(B) INT_re2		
INTDAY	-.0011396	-.0011203	-.0000193	.0000282
FIRMSIZE	1.318312	1.293293	.0250188	.3256428
LEVERAGE	.0192817	.0210125	-.0017308	.0027057

b = Consistent under H0 and Ha; obtained from xtreg.
 B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
 = 0.87
 Prob > chi2 = 0.8316

 **Wooldridge test for autocorrelation**

. xtserial GPM INTDAY FIRMSIZE LEVERAGE

Wooldridge test for autocorrelation in panel data
 H0: no first-order autocorrelation
 F(1, 472) = 4.791
 Prob > F = 0.0291

4. Model 4a and model 4b

$$\text{Model 4a: } \text{GPM}_{i,t} = \beta_0 + \beta_1 \cdot \text{CCC}_{i,t} + \beta_2 \cdot \text{GDP}_{i,t} + \beta_3 \cdot \text{LEV}_{i,t} + \varepsilon_{i,t}$$

✚ Regression results and multicollinearity test

❖ FEM

```
. xtreg GPM CCC GDP LEVERAGE, fe
```

```
Fixed-effects (within) regression      Number of obs   =   3,569
Group variable: firmid                 Number of groups =    501

R-squared:                             Obs per group:
  Within = 0.0478                       min =          1
  Between = 0.0230                      avg =         7.1
  Overall = 0.0263                      max =          9

corr(u_i, Xb) = 0.0025                  F(3, 3065)      =   51.32
                                         Prob > F        =   0.0000
```

GPM	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
CCC	-.0011948	.0001006	-11.87	0.000	-.0013921	-.0009974
GDP	-1.052139	.4445323	-2.37	0.018	-1.92375	-.1805275
LEVERAGE	.0191977	.0075199	2.55	0.011	.0044533	.0339422
_cons	29.76509	2.877426	10.34	0.000	24.12321	35.40697
sigma_u	18.300008					
sigma_e	14.59251					
rho	.61130148	(fraction of variance due to u_i)				

```
F test that all u_i=0: F(500, 3065) = 10.72      Prob > F = 0.0000
```

```
. est sto CCC_fe1
```

```
. vif, uncentered
```

Variable	VIF	1/VIF
GDP	1.22	0.817504
LEVERAGE	1.22	0.820664
CCC	1.00	0.995574
Mean VIF	1.15	

❖ REM

. xtreg GPM CCC GDP LEVERAGE, re

```

Random-effects GLS regression           Number of obs   =   3,569
Group variable: firmid                 Number of groups =   501

R-squared:                             Obs per group:
  Within = 0.0477                       min =          1
  Between = 0.0242                      avg =          7.1
  Overall = 0.0271                      max =          9

corr(u_i, X) = 0 (assumed)              Wald chi2(3)    =   164.97
                                          Prob > chi2     =   0.0000

```

GPM	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
CCC	-.0011892	.0000974	-12.22	0.000	-.00138	-.0009984
GDP	-.8897168	.4424823	-2.01	0.044	-1.756966	-.0224674
LEVERAGE	.022479	.0068455	3.28	0.001	.0090621	.0358959
_cons	28.07729	2.959395	9.49	0.000	22.27698	33.8776
sigma_u	17.044591					
sigma_e	14.59251					
rho	.57704368					

(fraction of variance due to u_i)



. est sto CCC_re1

. vif, uncentered

Variable	VIF	1/VIF
GDP	1.22	0.817504
LEVERAGE	1.22	0.820664
CCC	1.00	0.995574
Mean VIF	1.15	

✚ Hausman test FEM vs REM

. hausman CCC_fe1 CCC_re1

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
	(b) CCC_fe1	(B) CCC_re1		
CCC	-.0011948	-.0011892	-5.60e-06	.0000255
GDP	-1.052139	-.8897168	-.1624221	.0426423
LEVERAGE	.0191977	.022479	-.0032812	.0031125

b = Consistent under H0 and Ha; obtained from xtreg.
 B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
 = 15.02
 Prob > chi2 = 0.0018

✚ Wooldridge test for autocorrelation

. xtserial GPM CCC GDP LEVERAGE

Wooldridge test for autocorrelation in panel data
 H0: no first-order autocorrelation
 F(1, 470) = 3.578
 Prob > F = 0.0592

Model 4b: $GPM_{i,t} = \beta_0 + \beta_1 * CCC_{i,t} + \beta_2 * FSIZE_{i,t} + \beta_3 * LEV_{i,t} + \epsilon_{i,t}$

Regression results and multicollinearity test

❖ FEM

. xtreg GPM CCC FIRMSIZE LEVERAGE, fe

```

Fixed-effects (within) regression           Number of obs   =       3,840
Group variable: firmid                     Number of groups =        501

R-squared:                                 Obs per group:
  Within = 0.0459                          min =           1
  Between = 0.0372                          avg =           7.7
  Overall = 0.0323                          max =           11

corr(u_i, Xb) = -0.0088                    F(3,3336)       =       53.55
                                           Prob > F        =       0.0000
  
```

GPM	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
CCC	-.0011896	.0000994	-11.96	0.000	-.0013846	-.0009946
FIRMSIZE	1.399072	.4919292	2.84	0.004	.4345582	2.363585
LEVERAGE	.0197282	.0071676	2.75	0.006	.0056749	.0337816
_cons	4.175151	6.649902	0.63	0.530	-8.863148	17.21345
sigma_u	18.135515	Vietnamese-German University				
sigma_e	14.466754					
rho	.61112366	(fraction of variance due to u_i)				

F test that all u_i=0: F(500, 3336) = 11.63 Prob > F = 0.0000

. est sto CCC_fe2

. vif, uncentered

Variable	VIF	1/VIF
FIRMSIZE	1.26	0.792782
LEVERAGE	1.26	0.796225
CCC	1.01	0.995003
Mean VIF	1.17	

❖ REM

. xtreg GPM CCC FIRMSIZE LEVERAGE, re


```

Random-effects GLS regression           Number of obs   =   3,840
Group variable: firmid                 Number of groups =   501

R-squared:                               Obs per group:
  Within = 0.0459                        min =          1
  Between = 0.0374                       avg =         7.7
  Overall = 0.0326                       max =         11

corr(u_i, X) = 0 (assumed)              Wald chi2(3)    =   178.83
                                          Prob > chi2     =   0.0000
  
```

GPM	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
CCC	-.0011842	.0000962	-12.32	0.000	-.0013727	-.0009957
FIRMSIZE	1.331086	.3689248	3.61	0.000	.6080071	2.054166
LEVERAGE	.0213196	.006638	3.21	0.001	.0083094	.0343298
_cons	4.452565	5.005958	0.89	0.374	-5.358933	14.26406
sigma_u	17.168968					
sigma_e	14.466754					
rho	.58479787					



 (fraction of variance due to u_i)

 Vietnamese-German University

. est sto CCC_re2

. vif, uncentered

Variable	VIF	1/VIF
FIRMSIZE	1.26	0.792782
LEVERAGE	1.26	0.796225
CCC	1.01	0.995003
Mean VIF	1.17	

 **Hausman test FEM vs REM**

. hausman CCC_fe2 CCC_re2

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
	(b) CCC_fe2	(B) CCC_re2		
CCC	-.0011896	-.0011842	-5.40e-06	.0000254
FIRMSIZE	1.399072	1.331086	.0679853	.3254057
LEVERAGE	.0197282	.0213196	-.0015914	.002704

b = Consistent under H0 and Ha; obtained from xtreg.
 B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
 = 0.42
 Prob > chi2 = 0.9356

 **Wooldridge test for autocorrelation**

. xtserial GPM CCC FIRMSIZE LEVERAGE

Wooldridge test for autocorrelation in panel data
 H0: no first-order autocorrelation
 F(1, 472) = 4.885
 Prob > F = 0.0276



Vietnamese - German University



Statutory declaration

Full name: Nguyen Hoang Hai

Matriculation number: 14652

Thesis title: Impact of working capital management on firm's profitability: An empirical study on Vietnamese listed firms

Supervisor: Dr. Trinh Quoc Dat



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