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The Impact of Environmental Factors as Determinants of Abnormal Inventory Level: Decoding the Managerial Accounting Puzzle

تأثير العوامل البيئية كمحددات لمستوى المخزون غير العادي: فك لغز المحاسبة الإدارية

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The Impact of Environmental Factors as Determinants of Abnormal Inventory Level: Decoding the Managerial Accounting Puzzle

Abstract

This paper investigates the impact of internal and external environmental factors as determinants of abnormal inventory. The internal environmental factors include financial conditions, capital intensity, cash flow, sales growth and volatility, gross margin, trade credit, lead time, and firm size. Market power, price volatility, economic policy uncertainty, and inflation rate are considered external environmental factors that influence abnormal inventory. Secondary data were collected for a sample of fifty-two Egyptian firms listed in the EGX 100 index over the period from 2016-2023. Data collected is analyzed using Ordinary Least Squares (OLS) regression with robust command and Panel Corrected Standard Error (PCSE) which is employed only with panel data. Statistical results revealed that internal and external environmental factors have a significant impact on abnormal inventory. Specially, firm's size has a significant positive impact on abnormal inventory. In contrast, sales growth, sales volatility, financial conditions, gross margin capital intensity, and economic policy uncertainty have a significant negative impact on abnormal inventory. In addition to that cash flow, lead time, trade credit market power, and price volatility are not significantly related to abnormal inventory. Inflation is excluded due to multicollinearity with price volatility which implies higher R-squared. The research is limited by the sample size as it is applied on Egyptian firms only. Additionally, the sample was selected from EGX 100 index excluding other listed firms. This research might provide some explanation for managerial decisions regarding abnormal inventory and the appropriate inventory strategy. This research might be considered one of the pioneer papers in examining the relationship between the environmental factors and inventory strategy. Importantly, research findings might be used by managers as a guidance for their managerial decisions regarding inventory level in light of the contingent factors faced by their firm.

Keywords Abnormal inventory; Environmental internal factors; Environmental external factors; Inventory levels managerial decision

ملخص البحث

يبحث هذا البحث في تأثير المحددات البيئية الداخلية والخارجية كمحددات للمخزون غير العادي. وتشمل المحددات البيئية الداخلية الظروف المالية، وكثافة رأس المال، والتدفق النقدي، ونمو المبيعات وتقلبها، والهامش الإجمالي، والائتمان التجاري، والمهلة الزمنية، وحجم الشركة. تعتبر قوة السوق، وتقلب الأسعار، وعدم اليقين في السياسة الاقتصادية، ومعدل التضخم من المحددات البيئية الخارجية التي تؤثر على المخزون غير العادي. وتم جمع بيانات ثانوية لعينة مكونة من اثنين وخمسين شركة مصرية مدرجة في مؤشر EGX 100 خلال الفترة من 2016 إلى 2023. و قد تم تحليل البيانات التي تم جمعها باستخدام انحدار المربعات الصغرى العادية (OLS) والخطأ القياسي المصحح لبيانات سلاسل مقطعية (PCSE) والذي يتم استخدامه فقط مع بيانات

السلاسل المقطعية. أظهرت النتائج الإحصائية أن المحددات البيئية الداخلية والخارجية لها تأثير معنوي على المخزون غير العادي. وعلى وجه الخصوص، فإن حجم الشركة له تأثير إيجابي معنوي على المخزون غير العادي. في المقابل، فإن نمو المبيعات، وتقلبات المبيعات، والظروف المالية، وإجمالي كثافة رأس المال الهامش، وعدم اليقين في السياسة الاقتصادية لها تأثير سلبي معنوي على المخزون غير العادي. بالإضافة إلى ذلك التدفق النقدي، فإن المهلة الزمنية، وقوة سوق الائتمان التجاري، وتقلب الأسعار لا ترتبط بشكل معنوي بالمخزون غير العادي. تم استبعاد التضخم بسبب التعددية الخطية مع تقلب الأسعار. يقتصر البحث على حجم العينة حيث يتم تطبيقه على الشركات المصرية فقط. بالإضافة إلى ذلك، تم اختيار العينة من مؤشر EGX 100 مع استبعاد الشركات الأخرى المقيدة. قد يقدم هذا البحث بعض التفسيرات للقرارات الإدارية المتعلقة بالمخزون غير العادي واستراتيجية المخزون المناسبة. يمكن اعتبار هذا البحث من الأبحاث الرائدة في دراسة العلاقة بين المحدات البيئية واستراتيجية المخزون. والأهم من ذلك، يمكن للادارة استخدام نتائج البحوث كدليل لقراراتهم الإدارية فيما يتعلق بمستوى المخزون في ضوء العوامل الطارئة التي تواجهها شركاتهم

كلمات رئيسية: المخزون الغير عادي، محددات البيئة الداخلية، محددات البيئة الخارجية، القرارات الإدارية الخاصة بمستوي المخزون.

1. Introduction

According to contingency theory, firms need to align their systems and structures with the specific contingencies or circumstances of both internal and external environments to enhance profitability (Danese, 2011). This implies that management of inventory levels should be adapted to fit the unique characteristics and demands of each firm's environment. According to conservative inventory strategy, if a firm operates in an uncertain and volatile market with fluctuating customer demand, the contingency theory suggests that it may be beneficial to maintain higher levels of inventory as a buffer to meet potential spikes in demand (Carpenter et al., 1998). In aggressive inventory strategy, in a stable and predictable market, the theory may suggest that lower levels of inventory are more appropriate to avoid the costs associated with excess inventory (Kolias et al., 2011). Contingency theory recognizes that there is no one-size-fits-all approach to managing inventory and emphasizes the need to consider both internal and external factors and adapt strategies accordingly (Alves et al., 2017). Therefore, the main obstacle facing managerial accountants is to find the suitable inventory strategy (either conservative or aggressive) that best fits each firm. By aligning inventory management practices with the contingencies of the internal and external environment, firms can optimize their inventory levels and minimize the risk of abnormal inventory situations.

Abnormal inventory arises when there is a difference between the inventory change resulting from an increase in sales comparing with a decline in sales (Hwang et al., 2021). Both abnormally high (conservative) and low (aggressive) inventory are two main strategies for managing inventory. Abnormally high inventory or inventory stickiness arises if inventory experiences a smaller percentage decline when output levels decline than an equivalent percentage increase when output levels rise. Inventory is anti-sticky or abnormally low because it rises proportionately less when output levels rise and decreases more when output levels decline (Kroes & Manikas, 2018; Wang et al., 2022; Zhu et al., 2021). Both adopting a conservative and an aggressive inventory strategy are critical managerial decisions that might be influenced by the internal and external environment in which a firm operates. Therefore, an inventory strategy choice is subject to contingent or environmental factors that might influence managers' decisions regarding inventory levels.

Environmental determinants might be either internal or external factors. Internal environmental factors that might affect managers' decisions regarding inventory level include: (1) financial conditions (Afrifa, 2016; Goldberg et al., 2009; Hill et al., 2017; Hoberg et al., 2017; Hofmann et al., 2022; Machokoto et al., 2022; Steinker et al., 2016); (2) capital intensity (Chen et al., 2007; Gaur et al., 2005; Hoberg et al., 2017; Kolias et al., 2011; Mielcarz et al., 2018; Sahari et al., 2012; Sangalli, 2013; Yousaf & Dehning, 2023); (3) cash flow (Afrifa, 2016; Serrasqueiro & Azevedo, 2016; Celestine et al., 2023; Cunningham, 2011; Hill et al., 2010); (4) sales growth and volatility (Afrifa et al., 2021; Guariglia & Mateut, 2010; Kolias et al., 2011; Sangalli, 2013); (5) gross margin (Gaur et al., 2005; Hoberg et al., 2017; Kim, 2022; Kolias et al., 2011; Wu et al., 2019; Yousaf & Dehning, 2023); (6) trade credit (Afrifa et al., 2021); (7) lead time (Hoberg et al., 2017); (8) firm size (Serrasqueiro & Azevedo, 2016; Bustos, 2023; Theodossiou et al., 1996; Tripathi & Kochhar, 2016). External environmental factors that might affect managers' decisions regarding inventory level include: (1) market power;(2) economic policy uncertainty; (3) price volatility; (4) inflation (Serrasqueiro & Azevedo, 2016; Celestine et al., 2023; Thille, 2006; Tripathi & Kochhar, 2016). Both internal and external factors are considered in this research.

Prior literature examined the inventory relationship with market reaction (Cook et al., 2022), corporate social responsibility (Lin et al., 2019), corporate governance mechanisms (Elsayed & Wahba, 2013), managerial ability (Nurfauzi & Firmansyah, 2018), tax aggressiveness (Ann & Manurung, 2019), stock return (Bendig et al., 2018), financial constraints (Bo, 2001), financial distress (Steinker et al., 2016), managerial approaches (Chikán, 2009) and productivity (Wang et al., 2022). Although these studies tested the effect of abnormal inventory as an independent variable that affects different dependent variables, yet little literature has discussed environmental factors that affect

abnormal inventory. Consequently, the main objective of this research is to examine the environmental determinants (internal and external environmental factors) that might influence abnormal inventory.

By applying on sample of Egyptian manufacturing firms from 2016-2023, the researcher tests the effect of environmental determinants on abnormal inventory. The environmental determinants are categorized into two main groups including internal and external environmental factors. First, internal environment factors include financial conditions, capital intensity, cash flow, sales growth, sales volatility, trade credit, lead time, and size. Second, external environment factors include market power, price volatility, economic policy uncertainty, and inflation. The ordinary linear regression (OLS) and Panel Corrected Standard Error (PCSE) are occupied. The following results are found: firm's size has a significant positive impact on abnormal inventory. On the opposite, financial conditions, sales growth, sales volatility, gross margin, capital intensity, and economic policy uncertainty have a significant negative impact on abnormal inventory. In addition to that, cash flow, lead time, trade credit, market power, and price volatility are not significantly related to abnormal inventory. . Inflation is excluded due to multicollinearity with price volatility which implies higher R-squared.

This research attempts to make some contributions to the existing literature addressing the relationship between the environmental factors and inventory strategy. First, it might be considered one of the pioneer papers in examining the environmental determinants both internally and externally of abnormal inventory. Secondly, the current research employs an advanced method to calculate abnormal inventory. Prior literature mainly used inventory turnover, inventory to sales, and inventory exact amount to measure inventory (Chen et al., 2007; Kolias et al., 2011; Koumanakos, 2008; Hameri et al., 2017). This research extends prior literature by using a predicted model to measure specifically abnormal inventory. Although Afrifa et al., (2021) used a predicted model to measure abnormal inventory, they ignored the effect of external environmental factors on abnormal inventory. Third, and most importantly, this research may provide some explanation for managerial decisions regarding abnormal inventory. Practically, this research could help firms adopt a suitable inventory strategy in light of the contingent factors faced by each firm. Management might use this research as a guidance for their managerial decisions regarding inventory.

The remaining part of this paper is organized as follows: abnormal inventory: definition, motives, benefits, and costs addressed in section (2). The literature review and hypotheses development are included in Section (3). Section (4) covers empirical study. The final section contains conclusions, limitations, and future research.

2. Abnormal inventory: definition, motives, benefits, and costs

Inventory is a managerial decision that is considered crucial for the success of firms as it requires a significant amount of working capital. However, finding the right balance of inventory level remains a major challenge for firms. It is important to strike a balance between having too much inventory, which can result in increased storage, spoilage, and insurance costs, as well as potential capital investment losses, and having too low inventory, which can lead to unmet customer demand and loss of sales. When sales decline, managers are faced with the decision of whether to maintain inventory despite the additional costs or to build up buffer inventory (Biggs & Price, 2021; Kamau & Assumpta, 2015; Katehakis et al., 2016; Singh & Singh, 2013). Abnormal inventory occurs when the change in inventory for an increase in sales is different from the change in inventory for a decrease in sales. This means that the inventory-to-sales ratio is not the same for positive and negative sales fluctuations (Holly & Turner, 2001).

Managers could choose between two main alternatives when managing inventory resulting in abnormally high or low inventory (Afrifa et al., 2021; Cook et al., 2022; Kesavan & Mani, 2010, 2013). When managers engage in the practice of maintaining abnormally high inventory or inventory stickiness, their tendency is to hold excess inventory even when sales are declining. Consequently, managers' decisions regarding inventory investments are anticipated to exhibit asymmetry, meaning that their response to sales increases will differ from their response to sales declines. During periods of declining sales, the change in inventory is relatively minor compared to when sales are increasing. This is because managers tend to continue holding high levels of inventory despite a decrease in sales (Hwang et al., 2021). Three primary reasons can account for inventory stickiness. Firstly, inventory stickiness occurs when the cost of adjusting inventory (often in the form of inventory scrap charges, write-offs, sell-offs at discounted prices, or the costs associated with disposing inventory and increasing inventory) outweighs the cost of storing it (Kroes & Manikas, 2018b; Zhu et al., 2021). Secondly, inventory stickiness serves as a buffer to mitigate environmental risks and streamline manufacturing processes, making it a crucial aspect. Lastly, managers are more inclined to adopt sticky inventory management practices when they are anticipating future sales (Basu & Wang, 2011; Kroes & Manikas, 2018; Wang et al., 2022).

Abnormally high inventory could be due to a precautionary motive or speculative motive theory. The precautionary motive or stock-out avoidance theory claims that production requires time and is therefore unable to react immediately to a demand shock, firms keep inventory to prevent sales chance losses (Wang et al., 2022). The speculative motive theory states that firms keep inventory on hand as a hedge for price movements or in inflation periods (Afrifa et al., 2021). Several costs are associated with keeping material on hand or

adopting a conservative inventory strategy, such as the cost of borrowing the capital committed or forgoing its use for another investment, insurance, the risk of obsolescence or spoilage, the cost of operating a warehouse, and taxes (Silver, 1981).

Managers exhibit a tendency known as abnormally low inventory or inventory anti-stickiness, where they prefer to hold minimal levels of inventory or even become entirely stockless when faced with declining sales. The abnormally low inventory could be due to Just-in-Time (JIT) or transaction cost theory. The former suggests keeping a zero level of inventory or stockless production (Vokurka & Davis, 1996). The JIT philosophy views inventory as inherently wasteful, as the cost of holding inventory results in unsolved problems (Cannon, 2008). Contrary to JIT, the latter is related to keeping the minimum required level of inventory that is essential to meet the expected demand. The Theory of Constraints (TOC) permits a small amount of stock to be kept before the process that moves slowly so that unanticipated delivery delays from other processes would not stop this important process (Sani & Allahverdizadeh, 2012). It must be noted, that firms following an aggressive approach when dealing with inventory could face a higher risk of stock-out and loss of sales than firms adopting a conservative inventory approach which could harm the firm value (Kamau & Assumpta, 2015).

It is important to consider that the manipulation of earnings through real activity adjustments such as overproduction or accrual manipulations involving inventory accounts can be a motive for abnormal inventory levels, whether they are low or high (Nugrahadi & Rinaldi, 2021). The production cost structure, represented by the fixed-to-variable manufacturing costs ratio, plays a role in the cost of goods sold (COGS) calculation. Changes in production volume and sales volume impact COGS due to the treatment of fixed manufacturing costs in absorption costing. Consequently, when production volume increases while sales volume remains the same, a smaller portion of fixed manufacturing costs is allocated to COGS, resulting in a higher allocation to inventory accounts and an increase in net income before taxes. Reducing production can lead to a decrease in net income before taxes, which presents another avenue for manipulating inventory (Cook et al., 2021, 2022; Elsayed, 2013).

In summary, inventory strategy choice is complicated. This could be due to two main reasons. First, either a conservative or aggressive inventory strategy adopted might be driven by different motives including speculative precautionary, JIT, and transaction motives. Secondly, a firm operates in an environment where it interacts with and is affected by it. Therefore, a manager's choice between low or high abnormal inventory might be influenced by environmental determinants (internally and externally).

3. Literature review and hypotheses development

Prior literature stated various environmental determinants that could affect inventory management. However, little literature examined the environmental determinants that affect abnormal inventory. Environmental determinants influencing abnormal inventory can be categorized into two main groups including internal and external environmental factors.

3.1 Internal environmental factors

Internal environmental factors are firm-specific factors that are related directly to the firm itself. *First*, financial conditions might affect abnormal inventory. The firm's financial conditions could be explained using financial distress and constraints. Financial distress occurs when a firm is facing significant financial difficulties and is unable to meet its financial obligations (Ghayour et al., 2022; Habib et al., 2020; Sari & Ismah, 2023; Theodossiou et al., 1996). Financial constraints refer to limitations or restrictions on a firm's ability to obtain external financing or raise capital (Guariglia, 1999). It is argued that financial distress can be considered an extreme manifestation of financial constraint, making financial constraint the more encompassing and general term. In other words, a firm experiencing financial distress is inherently facing financial constraints, but not all instances of financial constraint necessarily indicate financial distress (Bukalska & Maziarczyk, 2023; Hoberg et al., 2017).

When a firm faces financial distress, three levers are usually used to minimize its need for working capital: extending credit days to suppliers, decreasing credit days from customers, and optimizing inventory (Afrifa, 2016; Goldberg et al., 2009). While there has been much discussion in the financial literature on optimizing trade credit granted and received (Hill et al., 2017; Machokoto et al., 2022), abnormal inventory has been mostly focused during the previous few decades (Hoberg et al., 2017). This is true because firms facing either financial distress or constraints might behave differently from firms with strong financial positions especially when dealing with different inventory strategies (Hofmann et al., 2022).

Prior literature revealed a negative relationship between financial distress or constraints and inventory (Choi & Kim, 2001; Cunningham, 2011; Dasgupta et al., 2019; Muigai & Nasieku, 2021; Mwariri, 2020). The negative relation between financial distress or constraints and inventory relation has been tested using different proxies for inventory including the natural logarithm of inventory (Serrasqueiro & Azevedo, 2016; Guariglia, 1999; Sangalli, 2013), days to sell inventory (Hofmann et al., 2022; Steinker et al., 2016), inventory to sales ratio (Farooq et al., 2020), and inventory-to-total assets ratio (Bustos, 2023)

In summary, when a firm is in a financially distressed or constrained condition, it may face several challenges that can impact its inventory strategy. Reduction in purchasing power could be one of these challenges. Financial distress or high financial constraints often lead to cash flow problems, limiting a firm's ability to purchase inventory. The firm may not have sufficient funds to buy the desired quantity of inventory or may delay purchasing new inventory altogether. Additionally, inventory level reduction is another challenge. This can involve selling off excess inventory at discounted prices or implementing inventory control measures to minimize carrying cost. This is because if a firm cannot afford proper storage or maintenance of inventory, it may result in damaged or obsolete goods, reducing their value and marketability (Serrasqueiro & Azevedo, 2016; Bustos, 2023; Choi & Kim, 2001; Cunningham, 2011; Dasgupta et al., 2019; Guariglia, 1999; Muigai & Nasieku, 2021; Mwariri, 2020; Sangalli, 2013; Steinker et al., 2016)

Other literature revealed a positive relationship between financial distress or constraints and abnormal inventory (Guariglia & Mateut, 2010; Hoberg et al., 2017). Guariglia & Mateut, (2010) found that financially constrained firms are positively related to inventory investments. This was in line with Hoberg et al., (2017) who found that leaner firms usually maintain less inventory and they are probably less financially constrained due to tighter capital planning and better financial performance. This positive relationship between financial distress or constraints and abnormal inventory could be justified that high abnormal inventory, which refers to holding extra inventory during times of declining revenues, causes a decline in cash flow and exacerbates a firm's financial constraints. Firms typically maintain physical assets to strengthen their financing capabilities, which raises the stickiness of their inventory. This could suggest that inventory stickiness and financial constraints interact positively. However, when compared to firms with fewer financial constraints, firms with an increase in both variables (inventory and financial constraints) experience an increase in operational costs which increases the likelihood of failure (Zhu et al., 2021).

Second, abnormal inventory might be affected by capital intensity. Capital intensity refers to a firm's level of investment in fixed assets, such as warehouses, information technology, and logistics management systems (Mielcarz et al., 2018; Samarajeewa & Perera, 2020; Suryarini et al., 2021). Previous literature has shown conflicting findings regarding the relationship between capital intensity and abnormal inventory.

The association between inventory and capital intensity can be approached from two different perspectives. Previous literature has identified a negative correlation between capital intensity and abnormal inventory (Hoberg et al., 2017; Mielcarz et al., 2018; Sangalli, 2013). Chen et al., (2007) stated that investments in inventory can serve as a

temporary substitute for the necessary funding for fixed investments. Additionally, if a firm adopts an aggressive inventory strategy and reduces inventory investment, it may need to increase investments in other areas such as information technology to mitigate uncertainty and risk (Shah & Shin, 2007). The high costs associated with storing and managing inventory resulting from a conservative inventory strategy are costly and a drain on liquidity (Cook et al., 2022). Consequently, insufficient funding caused by excessive inventory makes it more challenging for manufacturing firms to invest in fixed assets (Cheng et al., 2020).

Other literature has found a positive relationship between investment in fixed assets and inventory (Gaur et al., 2005; Kolias et al., 2011; Sahari et al., 2012; Yousaf & Dehning, 2023). Wang et al., (2022) stated that high abnormal inventory can contribute to further improvements in capital intensity. Additionally, high abnormal inventory suggests that there is no need to increase investments in other areas to address production disruptions caused by environmental threats, indicating a smoother production process. Furthermore, there is strong evidence that investment in information technology (IT) positively impacts inventory performance (Tian & Wang, 2021). Over the long term, increased IT investment results in higher inventory turnover and reduced inventory holding costs (Li et al., 2008). Investments in IT have helped firms reduce inventory levels as a precaution against supply chain disruptions or unexpected increases in aggregate demand. Given the ongoing debate surrounding the relationship between capital intensity and abnormal inventory, further research is warranted.

Third, cash flow is considered as a determinant of inventory. Because it acts as an internal source of funding, the operating cash flow (OCF) is arguably the most significant of the cash flow statement's three components (Oruko & Mule, 2022). Prior literature suggested a positive linear relationship between cash flow and abnormal inventory. The availability of cash flow leads to more investments in working capital suggesting adopting a conservative inventory strategy (Afrifa, 2016; Hill et al., 2010). Serrasqueiro & Azevedo, (2016) and Celestine et al., (2023) found that the cash flow is positively correlated with investments in inventory using the natural logarithm of inventory and inventory turnover respectively. Other literature revealed that the relationship between cash flow and inventory is nonlinear (Cunningham, 2011).

Guariglia & Mateut, (2010) revealed that the relationship between cash flow and abnormal inventory is insignificant. Their results might be explained due to the given the contrasting impacts that cash flow may have on inventory investment. Higher demand results in higher cash flow, but firms may also need to lower their inventory levels in order to meet the rising demand. This could result in a poor link between cash flow and inventory investment. However, firms with greater cash flow can afford to hold more

inventory, suggesting a positive link between inventory investment and cash flow. These two opposing effects might cancel each other out if their magnitudes are equal, which would result in an insignificant effect. Moreover, cash flow may be extremely collinear, which makes it challenging to estimate the effect on inventory. This is another reason why cash flow can be found to be insignificant.

Fourth, the majority of prior literature used sales as a proxy for inventory level which implies a strong relationship between sales and inventory. Therefore, sales growth and volatility are included in this research to examine their effect on abnormal inventory. Sales growth is identified as one of the internal environmental factors that affects abnormal inventory. Sales growth is the difference between sales in two preceding periods. Prior literature suggested a negative relationship between sales growth and abnormal inventory. According to Kolias et al., (2011) examination of the relationship between sales growth rate and inventory turnover, they found that when firms operate in a "sales-declined region", sales fluctuations have a greater effect on inventory turnover than when firms operate in a "sales-increased region". This could be justified as when a firm experiences rapid sales growth, it may struggle to adjust its inventory levels quickly enough to keep up with increasing demand. This can lead to abnormal inventory levels, such as stock-outs or low abnormal inventory. Conversely, if a firm experiences declining sales, it may face challenges in effectively reducing its inventory levels in line with the reduced demand. This can result in high abnormal inventory, where the firm holds more inventory than necessary due to outdated sales forecasts or difficulties in scaling back production and supply. Other literature suggested a positive relationship between sales growth and abnormal inventory (Guariglia & Mateut, 2010; Sangalli, 2013). Therefore, the effect of sales growth on inventory is not clear from previous literature (Hill et al., 2010).

Fifth, the effect of sales volatility on abnormal inventory might be significant. Sales volatility refers to the degree of fluctuation or variability in a firm's sales over a given period. Increased sales volatility might make inventory management more difficult. Demand forecasting becomes more challenging when sales are unpredictable (Kolias et al., 2011; Tripathi & Kochhar, 2016). Due to supply and demand imbalances brought on by sales uncertainty, stock-outs or excess inventory may occur. Therefore, abnormal inventory levels may arise. Firms may adopt a conservative inventory strategy by overestimating demand and accumulating excessive inventory to prevent stock-outs during times of high sales volatility. Conversely, if a firm undervalues demand during times of volatility, it could see stock-outs or abnormally low inventory levels. Unsatisfied customers and loss of sales opportunities can arise from low abnormal inventory.

Prior literature revealed a positive relationship between sales volatility and abnormal inventory (Gaur et al., 2005; Kim, 2022; Kolias et al., 2011; Yousaf & Dehning, 2023).

Advocates for the positive relationship between sales volatility and abnormal inventory suggested that high sales volatility may require firms to adopt a conservative inventory strategy. Therefore, firms carry additional safety stock or buffer inventory to mitigate the risk of stock-outs. This can tie up working capital and increase carrying costs, potentially impacting cash flow and profitability. While low sales volatility may require firms to adopt an aggressive inventory strategy. This can increase the likelihood of customer dissatisfaction and loss of sales in case of sudden demand.

Sixth, prior literature examined gross margin as a determinant of abnormal inventory. Some literature revealed a negative relationship between gross margin and abnormal inventory (Gaur et al., 2005; Kolias et al., 2011; Wu et al., 2019; Yousaf & Dehning, 2023). Hoberg et al., (2017) stated that firms with greater gross margins generally incur higher stock-out costs. Therefore, they should stock up on more inventory. Kim,(2022) added that gross margin and inventory relationship differ across different quantile regression analyses. Other literature revealed that the relationship between gross margin and abnormal inventory is insignificant (Wang et al., 2022; Yiu & Wu, 2021). Therefore, the effect of gross margin on abnormal inventory is not precisely determined.

Other factors might affect abnormal inventory. It is debatable how Trade Credit (TC) affects abnormal inventory (Sheng et al., 2013). TC received allows for payment delays and reduces the amount of capital invested. Larger inventory holdings become practicable by this, which also lowers holding costs. However, depending on TC granted allows for adopting a conservative inventory strategy to cope with sales growth. Lead time may affect abnormal inventory. Lead time refers to the time it takes for an order to be fulfilled from the moment it is placed. Due to increased safety stock and in-transit inventory, longer lead times typically translate into larger inventory levels (Hoberg et al., 2017). Firm size is considered to affect abnormal inventory. Total assets, net revenue, and workforce size were used to measure the size of the firm (Rahman & Yilun, 2021). Prior literature revealed a positive relationship between firm size and abnormal inventory (Serrasqueiro & Azevedo, 2016; Celestine et al., 2023; Theodossiou et al., 1996; Tripathi & Kochhar, 2016). Bustos, (2023) found that size does not affect inventory using inventory to total assets ratio.

Consequently, prior literature revealed a positive relation between internal environmental factors and abnormal inventory. Regarding financial conditions, some literature declared a positive relationship between both financial distress and constraints and abnormal inventory (Guariglia & Mateut, 2010; Hoberg et al., 2017). Concerning capital intensity, prior literature found a positive relationship between capital intensity and abnormal inventory (Gaur et al., 2005; Kolias et al., 2011; Sahari et al., 2012; Yousaf & Dehning, 2023). Regarding cash flow, prior literature suggested a positive linear relationship

between cash flow and abnormal inventory (Afrifa, 2016; Serrasqueiro & Azevedo, 2016; Celestine et al., 2023; Hill et al., 2010). While Guariglia & Mateut, (2010) and Sangalli, (2013) revealed that sales growth is positively correlated with inventory. Some literature found a positive relationship between sales volatility and abnormal inventory (Gaur et al., 2005; Kolias et al., 2011; Yousaf & Dehning, 2023).

Contrarily, some literature revealed a negative relation between internal environmental factors and abnormal inventory. Regarding financial conditions, prior literature suggested a negative relationship between firm's financial conditions including financial distress and constraints and abnormal inventory (Serrasqueiro & Azevedo, 2016; Bustos, 2023; Choi & Kim, 2001; Cunningham, 2011; Dasgupta et al., 2019; Guariglia, 1999; Muigai & Nasieku, 2021; Mwariri, 2020; Sangalli, 2013; Steinker et al., 2016). Concerning capital intensity, a prior literature review found a negative relationship between capital intensity and abnormal inventory (Hoberg et al., 2017; Mielcarz et al., 2018; Sangalli, 2013). While, prior literature declared a negative relationship between sales growth and abnormal inventory (Kolias et al., 2011). Additionally, prior literature revealed a negative relationship between gross margin and abnormal inventory (Gaur et al., 2005; Kolias et al., 2011; Wu et al., 2019; Yousaf & Dehning, 2023).

Based on the prior literature, the first null hypothesis and its sub-hypotheses are developed as followed:

H_{01}: There is no significant relationship between internal environmental factors and abnormal inventory levels.

H_{11}: There is no significant relationship between financial conditions and abnormal inventory.

$H_{.2}$: There is no significant relationship between capital intensity and abnormal inventory.

H_{13}: There is no significant relationship between cash flow and abnormal inventory.

H_{14}: There is no significant relationship between sales growth and abnormal inventory.

H_{15}: There is no significant relationship between sales volatility and abnormal inventory.

H_{16}: There is no significant relationship between gross margin and abnormal inventory.

H_{17}: There is no significant relationship between Trade credit and abnormal inventory.

H_{18}: There is no significant relationship between lead time and abnormal inventory.

H_{19}: There is no significant relationship between firm size and abnormal inventory.

3.2 External environmental factors

External environmental factors include both industry-specific and macroeconomic factors. Using a questionnaire, Tripathi & Kochhar, (2016) found that a competitive environment or market power has an insignificant effect on a retailer's inventory. The lagged ratio of a firm's yearly sales to the overall yearly sales in a certain industry is used to calculate market power, with higher ratios suggesting stronger bargaining power. However, firms with high market power prefer adopting a conservative inventory strategy due to the availability of cash (Hill et al., 2010).

Price volatility might affect abnormal inventory. When prices are unstable, customer behavior may change, leading to fluctuations in demand. If a firm fails to accurately predict these changes, it can result in abnormal inventory levels. High price volatility may discourage customers from buying resulting in high abnormal inventory. Price volatility can affect abnormal inventory through either cost or demand shocks. Cost shocks arise when the prices of raw materials or finished goods experience significant fluctuations. Therefore, cost shocks can lead managers to adopt a conservative inventory strategy to avoid price fluctuation. Demand shocks arise when there is a sudden demand in the market. This sudden demand might lead firms to sell more inventory suddenly resulting in an aggressive inventory strategy (Thille, 2006).

Concerning the inflation rate, Celestine et al., (2023) found that the inflation rate is insignificantly related to inventory. Moreover, they suggested that tax and exchange rates might affect inventory. Economic policy uncertainty (EPU) refers to the risk associated with ambiguous changes in the macroeconomic regulatory, fiscal, tax regime, and monetary policies, which seems to have greater consequences than short-term economic downturns (Jory et al., 2020). When there is a high EPU, firms may delay making investment decisions, including decisions related to inventory. Additionally, EPU can lead to hesitation in customer decisions to buy, which can in turn affect demand for inventory. If customers and firms are uncertain about future economic conditions, they may reduce their spending and postpone purchases. This can result in lower demand for inventory, leading to low abnormal inventory levels. Additionally, Serrasqueiro & Azevedo, (2016) revealed that financial crisis is negatively related to inventory. Literature usually ignores the effect of industry and macroeconomic factors as external environmental factors on asymmetric inventory. Therefore, the second null hypothesis and its sub-hypotheses are developed as followed:

H_{02}: There is no significant relationship between external environmental factors and abnormal inventory levels.

H_{21}: There is no significant relationship between market power and abnormal inventory.

H_{22}: There is no significant relationship between EPU and abnormal inventory
H_{23}: There is no significant relationship between price volatility and abnormal inventory.
H_{24}: There is no significant relationship between the inflation rate and abnormal inventory

Gathering internal and external environmental factors as independent factors or variables and abnormal inventory as dependent variable in regression equation can be considered as third hypothesis. The third null hypothesis can be formulated as follows.

H_{03}: There is no significant relationship between environmental factors either internal or external and abnormal inventory levels.

Environmental factors in the third hypothesis are measured by nine internal and four external sub-factors. This hypothesis reflects the main research problem which is exploring the impact of environmental factors on abnormal inventory levels in firm. However, these three hypotheses are represented in the empirical section in three separate equations, each equation reflects one of these hypotheses.

4. The Empirical study

The empirical study includes sample selection and sources of data, research model and variable measurements, descriptive statistics, correlation matrix, diagnostic statistics, regression analysis, robustness tests, and discussion of the statistical results.

4.1 Sample selection and sources of data

One of the study's goals is to examine the contingent factors that affect abnormal inventory level. The sample is primarily gathered from firms listed on EGX 100 index. The secondary data is collected for 8 years from the year 2016 through 2023 (unbalanced-panel following (Afrifa et al., (2021) and Aktas et al., (2015)). Since data collected depends on cross-section data analysis for a time series (2016-2023), therefore, it considered panel data. The data extracted from annual reports accessible on Thomson Reuters Refinitiv. The final sample is chosen based on the criteria listed below:

1. Banks, investment and financial firms, holding leasing, and insurance firms will be excluded due to their special nature (Afrifa et al., 2021; Noman, 2023). Financial services firms vary from typical firms in that they typically have significantly larger leverage and enhanced susceptibility to financial risks, which is the main reason for this exclusion (Foerster & Sapp, 2005). Therefore, Financial firms (5 firms), Banks (12 banks) were excluded.

2. Sectors with less than six firms are excluded. This is because it is less likely to generate statistically significant results with a smaller sample size, which could lead to misleading or unreliable results (Hill et al., 2010). Therefore, the following sectors were excluded from the sample: Industrial, goods, services, and automobiles (3 firms), Contracting and construction engineering (4 firms), Energy (2 firms), Education (2 firms), Utilities (2 firms), Trade and distributors (2 firms), Shipping and distribution (2 firms), Textile and durables (4 firms), Building materials (4 firms), Travel and leisure (2 firms).
3. Firms with more than 30% of their data missing are excluded (Aktas et al., 2015). Therefore, a firm from real estate and 3 firms from basic resources were excluded from the sample.

Accordingly, the final sample includes 52 firms from 5 sectors according to the Egyptian Stock Exchange Industry Group Name classification. The majority of the sample are real estate firms (33%), followed by basic material firms (25%), and then food, beverage, and tobacco firms (20%). Both IT, media, and communication (11%) and health care and pharmaceuticals firms (11%) are minority in the sample.

4.2 Research models and variable measurements

The empirical section includes three hypotheses. Each of these hypotheses can be presented in linear multiple regression equation. Equation (1) represents the first hypothesis, in which abnormal inventory represents the dependent variable and the internal environmental factors represent the independent variables. However, it should be noted that within the empirical study, the abnormal inventory was measured using four different aspects, each reflects specific methodology of calculation. Two of them ($Abnormal_1$ and $Abnormal_2$) are measured based on the mean of the industry for inventory-to-sales and inventory turnover ratios respectively. While $Abnormal_{base}$ and $Abnormal_3$ are based on a determinants prediction model. $Abnormal_{base}$ is used mainly in this research for either one of two main reasons: (1) it provides the highest R-squared or, (2) it provides the lowest AIC (Akaike Information Criterion) and BIC (Bayesian Information Criterion). Equation (2) represents the second hypothesis, in which abnormal inventory represents the dependent variable and the external environmental factors represent the independent variables. Finally, Equation (3) is considered the baseline model as it is employed examine the impact of internal and external environmental factors on abnormal inventory. Therefore, the following models are used:

$$Abnormal_{i,t} = \beta_0 + \beta_1 Zscore_{i,t} + \beta_2 CI_{i,t} + \beta_3 OCF_{i,t} + \beta_4 SALESGROW_{i,t} + \beta_5 SALESVOL_{i,t} + \beta_6 GM_{i,t} + \beta_7 NTC_{i,t} + \beta_8 LEAD_{i,t} + \beta_9 SIZE_{i,t,t} + \xi_{i,t} \quad \text{Equation (1)}$$

$$Abnormal_{i,t} = \beta_0 + \beta_1 MPOWER_{i,t} + \beta_2 EPU_i + \beta_3 PPI_{i,t} + \beta_4 CPI_{i,t,t} + \xi_{i,t} \quad \text{Equation (2)}$$

$$Abnormal_{i,t} = \beta_0 + \beta_1 Zscore_{i,t} + \beta_2 CI_{i,t} + \beta_3 OCF_{i,t} + \beta_4 SALESGROW_{i,t} + \beta_5 SALESVOL_{i,t} + \beta_6 GM_{i,t} + \beta_7 NTC_{i,t} + \beta_8 LEAD_{i,t} + \beta_9 SIZE_{i,t} + \beta_{10} MPOWER_{i,t} + \beta_{11} EPU_i + \beta_{12} PPI_{i,t} + \beta_{13} CPI_{i,t,t} + \xi_{i,t}$$ .....Equation (3)

Where: $Abnormal_{i,t}$: abnormal Inventory for the firm (i) of the year (t); β_0: constant of the regression equation; β_i: parameters of the independent variables in the regression equation; $Zscore_{i,t}$: The dummy variable equals to measure financial conditions; $CI_{i,t}$: Capital intensity; $OCF_{i,t}$: Operating cash flow; $SALESGROW_{i,t}$: Sales growth; SALESVOL: Sales volatility; $GM_{i,t}$: Gross magin; $NTC_{i,t}$: Net trade credit ; $LEAD_{i,t}$: Lead time; $SIZE_{it}$: Size of the firm; MPOWER: Market power; EPU: Economic policy uncertainty; PPI: Price Volatility; CPI: Inflation. Table (1) illustrates the dependent and independent variables included in this research.

4.3 Descriptive statistics

Table (2) highlights the descriptive statistics for all variables employed in the current research. Regarding the abnormal inventory (the dependent variable), the mean of Egyptian listed firms included in the sample is 0.539 which implies that the average Egyptian listed firms apply high abnormal inventory. The minimum abnormal inventory is 0.053 while the maximum abnormal inventory is 1.648. The difference between the maximum and minimum abnormal inventory (1.595) is the range, which means that there is a variation across the firms represented in the standard deviation by 0.565. The value of the skewness and kurtosis is 1.08 and 2.492 respectively, where the skewness value should range from -3 to +3 and the value of kurtosis should be less than 20, indicating that the abnormal inventory data are normally distributed, this result will be confirmed in section 4.5 diagnostic statistic.

Concerning the independent variables, the operating cash flow mean is 0.513 which means that the average firms have a positive operating cash flow. While the capital intensity mean is 0.028 indicating that the average firms invest less in fixed assets when compared to total assets. The mean of the sales growth and sales volatility is 0.248 and 11.472 respectively indicating that there is an average increase in sales across the Egyptian firms by 24.8%. The gross margin mean is 0.336 indicating that the average firms are profitable. The net trade credit mean is 0.027 indicating the average firms depend more on granting trade credit rather than receiving trade credit. The average lead time is 3.663 which means that the average time firms take for an order to be fulfilled from the moment it is placed.

Table (1): Research variables, its symbols, and explanations

Variables	Symbol	Description (s)	References
Financial conditions	Z-score	The dummy variable equals 1 if the firm is financially distressed or constrained (below Altman's calculated threshold of 1.81) and 0 if the firm is not financially distressed or constrained. A firm financial distress or constraints is measured using Z-score as follows: Z-Score = 1.2 X1 + 1.4 X2 + 3.3 X3 + 0.6 X4 + 1.0 X5 Where X1 = Working Capital/Total Assets, X2 = Retained Earnings/Total Assets, X3 = Earnings before Interest and Taxes/Total Assets, X4 = Market Value of Equity/Book Value of Total Liabilities, X5 = Sales/Total Assets.	(Allison, 2009; Ghayour et al., 2022)
Capital intensity	CI	The ratio of capital expenditure to total assets	(Gaur et al., 2005; Kolias et al., 2011)
Operating cash flow	OCF	Operating income before extraordinary items plus depreciation, scaled by lagged fixed assets	(Oruko & Mule, 2022)
Sales growth	SALESGROW	$Sales_t$ – $Sales_{t-1}$ divided by $Sales_{t-1}$	(Kolias et al., 2011)
Sales volatility	SALESVOL	Sales volatility for a given year is the standard deviation of a firm's annual sales over the previous 2-year period	(Afrifa et al., 2021)
Gross Margin	GM	The ratio of sales after deducting the cost of goods sold from sales	(Gaur et al., 2005)
Net trade credit	NTC	(Accounts Receivable – Accounts Payable)/ Total Assets	(Detthamrong & Chansanam, 2023; Mahmud et al., 2022)
Lead time	LEAD	Days of payables outstanding	(Moser et al., 2021)
Firm size	SIZE	Natural logarithm of total assets.	(Bendig et al., 2018)
Market power	MPOWER	The lagged ratio of a firm's yearly sales to the overall yearly sales in a certain industry	(Hill et al., 2010)
Economic policy uncertainty	EPU	The World Uncertainty Index, which is used as an indicator of uncertainty in economic policy	(Selmey & Elamer, 2023)
Price volatility	PPI	The producer price index.	(Thille, 2006)
Inflation	CPI	The annual Consumer Price Index	(Elbannan & Elbannan, 2015; Sharaf, 2015)
Abnormal inventory	$Abnormal_{base}$	The difference between the actual and predicted inventory to sales for each firm per year. The actual inventory is actual inventory to sales for each year per sector. Therefore, abnormal inventory can be calculated as follows: Abnormal inventory ($\xi_{i,t}$) = Predicated inventory to sales-Actual inventory to sales The predicted inventory-to-sales ratio is the residual value in actual inventory to sales regression equation as follows: $\text{Inventory to sales}_{i,t} = \beta_0 + \beta_1 Zscore_{i,t} + \beta_2 CI_{i,t} + \beta_3 OCF_{i,t} + \beta_4 SALESGROW_{i,t} + \beta_5 SALESVOL_{i,t} + \beta_6 GM_{i,t} + \beta_7 NTC_{i,t} + \beta_8 LEAD_{i,t} + \beta_9 SIZE_{i,t} + \beta_{10} MPOWER_{i,t} + \beta_{11} EPU_i + \beta_{12} PPI_{i,t} + \beta_{13} CPI_{i,t,t} + \xi_{i,t}$	(Afrifa et al., 2021)

Table (2): Descriptive analysis

Variables	Obs	Mean	Std.Dev.	Min	Max	Skew.	Kurt.
$Abnormal_{base}$	389	.539	.565	.053	1.648	1.08	2.492
Capital intensity	389	.028	.027	0	.088	1.06	3.02
Operating cash flow	389	.513	.341	.151	.984	.327	1.425
Sales growth	389	.248	.289	-.14	.753	.404	2.025
Sales volatility	389	11.472	1.570	8.332	13.408	-.642	2.436
Gross margin	389	.336	.181	.034	.742	.425	2.903
Net trade credit	389	.027	.063	-.064	.138	.494	2.021
Lead time	389	3.663	.481	3.053	4.274	.062	1.451
Size	389	15.009	1.039	13.297	16.396	-.169	1.792
Market power	389	.068	.069	.002	.226	1.02	2.854
Economic policy uncertainty	389	.099	.063	0	.193	.295	2.054
Price volatility	389	5.348	.13	5.171	5.562	.415	1.8
inflation	389	4.677	.125	4.472	4.871	.0139	1.903
Financial conditions (Z-score)		**Freq.**		**Percent**		**Cumulative**	
0		256		65.81		65.81	
1		133		34.19		100.00	
Total		389		100.00			

The mean of the firm size is 15.009. The minimum and maximum values are 13.297 and 16.396 respectively with a range of 2.469. Both the standard deviation (1.039) and the range (2.469) indicate that there is high variation in the sample regarding firm size. The market power mean illustrates that the average firm's sales to the industry-year sales is 0.068. The price volatility, economic policy uncertainty, and inflation means are 5.348, 0.099, and 4.677 respectively. Concerning the Z-score, the majority of Egyptian firms are not financially distressed.

4.4 Correlation matrix

Table (3) reports the correlation matrix for the independent variables. The correlations between the independent variables range from 0.107 to 0.960. However, correlation coefficient reveal that there is a multicollinearity between price volatility and inflation which can be justified due to the relationship between the increase in prices between the producer and the consumer on the macroeconomic level. This was also confirmed when checking the multicollinearity using the variance inflation factor (VIF), where the VIF is 23.411 and 23.347 for price volatility and inflation respectively. As shown in the correlation matrix, the relationships between the price volatility and inflation are insignificant with abnormal inventory. Therefore, inflation, as an external environmental variable, is excluded from the regression analysis (Neter et al., 1996).

Table (3): Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Abnormal	1.000													
(2) Size	0.204*	1.000												
	(0.000)													
(3) Salesgrow	-0.080	0.045	1.000											
	(0.112)	(0.378)												
(4 Salesvol	-0.198*	0.557*	0.047	1.000										
	(0.000)	(0.000)	(0.358)											
(5) OCF	0.266*	0.032	0.195*	0.159*	1.000									
	(0.000)	(0.523)	(0.000)	(0.002)										
(6) CI	-0.526*	-0.050	-0.117*	0.041	-0.460*	1.000								
	(0.000)	(0.325)	(0.020)	(0.415)	(0.000)									
(7) GM	0.157*	0.000	0.195*	-0.005	0.377*	-0.322*	1.000							
	(0.002)	(0.998)	(0.000)	(0.929)	(0.000)	(0.000)								
(8) Mpower	-0.072	0.448*	0.002	0.327*	0.007	0.216*	-0.043	1.000						
	(0.155)	(0.000)	(0.966)	(0.000)	(0.882)	(0.000)	(0.390)							
(9) Lead	0.431*	0.077	-0.112*	-0.095	0.076	-0.346*	0.072	-0.154*	1.000					
	(0.000)	(0.128)	(0.026)	(0.060)	(0.133)	(0.000)	(0.152)	(0.002)						
(10) NTC	0.203*	-0.112*	0.045	-0.120*	0.119*	-0.126*	0.338*	-0.039	-0.250*	1.000				
	(0.000)	(0.026)	(0.378)	(0.017)	(0.018)	(0.012)	(0.000)	(0.441)	(0.000)					
(11) Z-score	0.394*	0.360*	-0.070	0.019	-0.277*	-0.125*	-0.156*	-0.049	0.272*	-0.028	1.000			
	(0.000)	(0.000)	(0.168)	(0.712)	(0.000)	(0.013)	(0.002)	(0.338)	(0.000)	(0.578)				
(12) PPI	0.077	0.111*	0.183*	0.054	0.108*	-0.048	0.113*	0.029	0.021	0.062	-0.060	1.000		
	(0.125)	(0.027)	(0.000)	(0.283)	(0.032)	(0.337)	(0.025)	(0.571)	(0.684)	(0.222)	(0.238)			
(13) CPI	0.097	0.110*	0.096	0.046	0.074	-0.057	0.107*	0.024	0.024	0.083	-0.052	0.960*	1.000	
	(0.055)	(0.029)	(0.056)	(0.361)	(0.142)	(0.263)	(0.034)	(0.637)	(0.641)	(0.102)	(0.305)	(0.000)		
(14) EPU	0.027	0.013	-0.018	0.032	0.005	-0.023	-0.009	0.000	0.016	0.014	-0.033	0.088	0.232*	1.000
	(0.598)	(0.791)	(0.725)	(0.523)	(0.920)	(0.642)	(0.858)	(0.997)	(0.758)	(0.782)	(0.514)	(0.081)	(0.000)	

****** p<0.01, ** p<0.05, * p<0.1***

4.5 Diagnostic statistics

Diagnostic statistics are completed before running the regression analysis in order to determine the fitness of the model. Diagnostic statistics include testing for multicollinearity, normality, heteroscedasticity, serial correlation, and omitted variables. Table (4) illustrates the results of the fitness of the model tests. Table (4) shows the variance inflation factor (VIF) of the baseline to check the multicollinearity among the independent variables. After excluding inflation, VIF ranged from 1.01 to 2.27 with the mean of 1.48. The range of VIF is below 10, therefore, there is no multicollinearity among the final independent variables.

Concerning normality, the Jarque-Bera test is used to test if used data followed normal distribution. The Prob > chi^2= .0939, which implies that Jarque-Bera test is close to zero, thus the data are normally distributed. This is also confirmed using Skewness and Kurtosis tests. To test for heteroscedasticity, the Breusch Pagan / Cook-Weisberg test is used. The Prob>chi^2 is 0.000 which implies that there is heteroscedasticity. To overcome heteroscedasticity problems, Robust regression is used. The Wooldridge test is used. To test the serial correlation, the p-value is equal to 0.9374, which is greater than 0.05, therefore, there is no serial correlation in the data used. To test for omitted variables, the Rasmey reset test is used. Since the p-value is equal 0.0000, which is less than 0.05,

therefore, there are omitted variables. To summarize the characteristics of data collected, there are heteroscedasticity and omitted variable issues. Additionally, the researchers perform a Wald test, also known as the F-test or the joint significance test (where the p-value<1, which implies that firm and year fixed effect should be considered) to evaluate the overall significance of a set of categorical variables (such as year and firm) in a regression model. Therefore, OLS using robust command while considering the fixed effects of both year and firm is used as statistical analysis tool (Noman, 2023). Furthermore, the fixed effects estimator may perform poorly in situations when there are few time periods compared to the number of cross-sectional units. In these situations, the Panel Corrected Standard Error (PCSE) approach may be used (Beck & Katz, 1995). Therefore, based on panel data analysis, PCSE is also used.

Table (4): The fitness of the model test

factor	Z-score	Capital intensity	Operating cashflow	Sales growth	Sales volatility	Gross margin	Trade credit	Lead time	Size	Market power	Economic policy uncertainty	Price volatility
VIF	1.63	1.69	1.67	1.13	1.62	1.408	1.32	1.45	2.27	1.48	1.01	1.08

Mean VIF	1.48
Normality(Jarque-Bera)	0.077
Omitted variable test (Ramsey Reset)	0.000
Heteroscedasticity (Breusch-Pagan / Cook-Weisberg test)	0.000
Serial correlation (Wooldridge test)	0.9374

4.6 Regression Analysis

Table (5) includes regression analysis in two ways: first OLS regression, second PCSE regression. OLS regression column is divided into 3 sub-columns, each shows the results of the three research models or equations: (1), (2), and (3) respectively. On the other hand, PCSE regression column is also divided into 3 sub-columns, each shows the results of the three research models or equations: (1), (2), and (3) respectively. For the baseline or general model, the R-squared is 0.862 in both regression equations, which means that each regression equation represents 86.2% of the factors affecting abnormal inventory level. Based on the baseline model results, concerning the internal environmental determinants, the Z-score relation with abnormal inventory is strongly significant at a 5 % level of significance. This implies that a ***decrease*** in financial condition by one standard deviation results in an increase in abnormal inventory by 11.2 percentage.

Concerning capital intensity, since p-value < 10% level of significance, capital intensity is statistically significantly associated with abnormal inventory level. The coefficient of capital intensity value is -0.033 (negative relationship) which implies that a *decrease* in capital intensity results in an increase in abnormal inventory by 3.3 percentage. Operating cash flow is found to have a positive statistically insignificant relation with abnormal inventory, where p-value in both models is more than 10%. Additionally, the relation between sales growth and abnormal inventory level is significantly negative in both regression models where p-value is equal 0.05 in both model. This means that an *increase* in sales growth is associated with a decrease in abnormal inventory according to the coefficient of the regression equation (-12.8%).

As shown in Table (5) line of sales volatility, since p-value < 1% level of significance, therefore, sales volatility is statistically significantly associated with abnormal inventory. The coefficient of sales volatility value is -0.073 (negative relationship) which implies that a *decrease* in sales volatility results in an increase in abnormal inventory by 7.3 percentage. The relationship between gross margin and abnormal inventory level is significantly negative, where p-value is less than 1% level of significance. This means that an *increase* in one standard deviation for gross margin results in a decrease in abnormal inventory by 72.5 percentage.

However, the relation between net trade credit and abnormal inventory is insignificant where p-value is greater than 10% level of significance. The association between lead time and abnormal inventory level is positively insignificant, where p-value is greater than 10% level of significance.

Finally, there are positive coefficients of size that are statistically significant at the 5% level of significance, with a coefficient value of the regression equation is 0.114 either in using OLS or PCSE. This means that the firm's size is positively related to abnormal inventory. This shows that an *increase* in firm size by one standard deviation results in 11.4 percentage increase in abnormal inventory level.

Concerning the external environmental determinants, the relation between market power and abnormal inventory is insignificantly negative where p-value is greater than 10% level of significance. The relationship between EPU and abnormal inventory level is insignificantly negative, where p-value is less than 10% level of significance. The relationship between price volatility and abnormal inventory level is insignificantly negative, where p-value is less than 10% level of significance.

Table (5): Regression analysis

Abnormal Inventory base	**OLS Regression**			**PCSE Regression**		
	Internal factors model	External factors model	Baseline model	Internal factors model	External factors model	Baseline model
	Coeff.	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
Internal environmental factors						
Z-score	.113**	-	.112**	.113**	-	.112**
Capital intensity	-.033*	-	-.033*	-.033*	-	-.033*
Operating cash flow	.063	-	.067	.063	-	.067
Sales growth	-.135**	-	-.128**	-.135**	-	-.128**
Sales volatility	-.074***	-	-.073***	-.074***	-	-.073***
Gross margin	-.717***	-	-.725***	-.717***	-	-.725***
Net trade credit	-.5	-	-.539	-.5	-	-.539
Lead time	.083	-	.077	.083	-	.077
Firm size	.107**	-	.114**	.107**	-	.114**
External environmental factors						
Market power	-	-1.732	-.565	-	-1.732	-.565
Economic policy uncertainty	-	3.018	-15.92	-	3.018	-15.92
Price volatility		.262	-.201		.262	-.201

Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-.881	.-1.309	1.252	-.881	-1.309	1.252
Number of observations	**389**	**389**	**389**	**389**	**389**	**389**
F-test	**125.394**	**135.489**	**126.964**	**-**	**-**	**-**
Prob > F	**0.000**	**0.000**	**0.000**	**-**	**-**	**-**
R-squared	**0.862**	**0.820**	**0.862**	**0.862**	**0.820**	**0.862**
(BIC)	**287.181**	**348.733**	**298.426**	**-**	**-**	**-**
(AIC)	**21.621**	**110.918**	**24.939**	**-**	**-**	**-**
Wald Chi^2	**-**	**-**	**-**	**9122.45**	**9134.40**	**9580.92**
Prob > Chi^2	**-**	**-**	**-**	**0.000**	**0.000**	**0.000**

****** p<.01, ** p<.05, * p<.1***

4.7 Robustness test

Three alternative measures for abnormal inventory are used in robustness testing. Two of them ($Abnormal_1$ and $Abnormal_2$) are based on the mean of the industry. $Abnormal_1$ is calculated as follows: first, the mean of inventory-to-sales of each sector is calculated, then compared the actual inventory-to-sales ratio for each firm per year with the mean of the sector. Finally, $Abnormal_1$ is the difference between the actual inventory-to-sales ratio of each firm per year and the mean of each sector and (Chen et al., 2007; Hameri et al., 2017). $Abnormal_2$ is calculated as follows: for each sector, the mean of inventory turnover ratio is calculated. Then, the actual inventory turnover ratio for each firm per year is compared with the mean of the sector. Finally, $Abnormal_2$ is the difference between the actual inventory turnover ratio of each firm per year and the mean inventory turnover ratio of each sector (Kolias et al., 2011; Koumanakos, 2008). $Abnormal_3$ is based on a lagged determinants prediction model. $Abnormal_3$ is calculated as follows: for each sector, the lagged determinants of abnormal inventory is used to run a regression of actual inventory-to-sales ratio. Then, the predicted inventory-to-sales ratio is calculated based on the residual of the previous regression. Finally, $Abnormal_3$ is the difference between the actual inventory-to-sales ratio and the predicted inventory-to-sales ratio for each firm per year (Afrifa et al., 2021).

Table (6): Robustness check

Factors	Abnormal $_1$ Coef.	Abnormal $_2$ Coef.	Abnormal $_3$ Coef.
Internal environmental factors			
Z-score	-.054	.002	.028
Capital intensity	.025	-.005	-.018
Operating cash flow	.27	.009	0
Sales growth	.21	-.039	.129**
Sales volatility	-.002	.001	-.014
Gross margin	.244	-.314***	-.514**
Net trade credit	-2.641*	-.052	.203
Lead time	-.126	.033*	.022
Firm size	-.301	.046**	.031
External environmental factors			
Market power	7.876***	-1.084***	-1.833
Economic policy uncertainty	-22.159	-1.196	-14.389
Price volatility	.549	-.08	-.129
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Constant	.3.329	-.438	1.602
Number of observations	**389**	**389**	**389**
F-test	**568.113**	**241.891**	**106.408**
Prob > F	**0.000**	**0.000**	**0.000**
R-squared	**0.949**	**0.842**	**0.851**
Bayesian crit. (BIC)	**1105.263**	**-590.888**	**336.514**
Akaike crit. (AIC)	**831.776**	**-864.375**	**63.027**

Table (6) represents the results of OLS regression of internal and external environmental factors on $Abnormal_1$, $Abnormal_2$, and $Abnormal_3$ respectively. Since $Abnormal_1$ and $Abnormal_2$ proxies are based on the mean of the industry while $Abnormal_{base}$ and $Abnormal_3$ proxies are based on the predicted model, results could vary among them. The adjusted R^2 are 94.9%, 84.2%, and 85.1% respectively at a 1% level of significance. Concerning $Abnormal_1$ and $Abnormal_2$, Z-score and capital intensity, sales growth, sales volatility, and operating cash flow are insignificant in both $Abnormal_1$ and $Abnormal_2$. Gross margin is insignificantly and significantly correlated in both regressions with a coefficient of .244 and -.314 respectively. Net trade credit is negatively correlated in both regressions at a 1% level of significance in $Abnormal_1$ (significant) and greater than 10% in $Abnormal_2$ (insignificant). Lead time is positively and negatively significant in both regressions respectively. Lead time is insignificant with a negative correlation with $Abnormal_1$ and positively significantly correlated with $Abnormal_2$ at a 10% level of significance. Size is insignificant with a negative correlation with $Abnormal_1$ and positively significantly correlated with $Abnormal_2$ at a 5% level of significance. Market power is statistically significant in both regressions. Economic policy uncertainty is negatively insignificant in both regressions. Price volatility is insignificant in both regressions. The variation in the

results could be justified mainly due to using the mean of the industry in both measuring abnormal inventory in $Abnormal_1$ and $Abnormal_2$, while $Abnormal_{base}$ is based mainly on a prediction model.

Concerning $Abnormal_3$, the results of $Abnormal_3$ regression are in line with $Abnormal_{base}$ regarding operating cash flow, gross margin, trade credit, lead time, market power, economic policy uncertainty, and price volatility. However, the results of $Abnormal_3$ regression are different from $Abnormal_{base}$ regression regarding sales growth, sales volatility, size, financial condition, and capital intensity. It must be noted that the BIC and AIC of $Abnormal_3$ regression is higher than $Abnormal_{base}$ regression which implies that $Abnormal_{base}$ regression is considered more fit than $Abnormal_3$ regression. This confirms that the static model used in measuring abnormal inventory in $Abnormal_{base}$ fits more than the model used in measuring $Abnormal_3$. Additionally, the R-squared is higher in the $Abnormal_{base}$ regression than the $Abnormal_3$ regression.

4.8 Discussion of the statistical results

The results of hypotheses testing are divided into three hypothesis testing. The first hypothesis is related to internal environmental determinants that affect abnormal inventory level. It divided into 9 sub-hypotheses. According to hypothesis testing, results reveal that internal determinants have a significant impact on abnormal inventory level. Therefore, the null hypothesis ($H_{0.1}$) is rejected, and the alternative hypothesis is accepted. In other words, statistical results revealed that there is a significant relationship between internal determinants and abnormal inventory level. The *first* sub-hypothesis tests the relation between a firm's financial condition and abnormal inventory level. Referring to prior literature, some literature indicated a positive, and other literature revealed a negative relation. Statistical results revealed a negative significant relation between the firm's financial condition and abnormal inventory level. The coefficient of the Z-score is 0.112 at a 5% significance level. This implies that if a firm Z-score increases by one standard deviation (decrease in the firm's financial condition), abnormal inventory level will increase by 11.2 percentage. This confirms with some other prior literature (Guariglia & Mateut, 2010; Hoberg et al., 2017) and does not confirm with other prior literature (Serrasqueiro & Azevedo, 2016; Bustos, 2023; Choi & Kim, 2001; Cunningham, 2011; Dasgupta et al., 2019; Guariglia, 1999; Muigai & Nasieku, 2021; Mwariri, 2020; Sangalli, 2013; Steinker et al., 2016). Firms typically hold more inventory to strengthen their financing capabilities when they are financially distressed or constrained, which raises the stickiness of their inventory. This could suggest that abnormal inventory level and financial conditions interact negatively

The *second* sub-hypothesis is related to testing the relationship between capital intensity and abnormal inventory level. There was a debate in prior literature regarding the significance and direction of this relationship. Statistical results showed that there is a significant negative relation between capital intensity and abnormal inventory level. As an increase in fixed assets investments by one standard deviation

leads to a decrease in abnormal inventory level by 3.3 percentage. This is in line with some prior literature (Chen et al., 2007; Cheng et al., 2020; Cook et al., 2022; Hoberg et al., 2017; Mielcarz et al., 2018; Sangalli, 2013; Shah & Shin, 2007) and is contradicted to other studies (Gaur et al., 2005; Kolias et al., 2011; Sahari et al., 2012; Yousaf & Dehning, 2023). This result implies that investing in fixed assets reduces the firm's ability to invest in inventory, which means that an increase in capital intensity results in low abnormal inventory.

The *third* sub-hypothesis is based on testing the relationship between operating cash flow and abnormal inventory level. Prior literature had debated about the significance and direction of this relation. Statistical results showed that there is an insignificant positive relation between operating cash flow and abnormal inventory level. This is in line with Guariglia & Mateut, (2010) and not in line with some prior literature (Afrifa, 2016; Serrasqueiro & Azevedo, 2016; Celestine et al., 2023; Hill et al., 2010). Cash flow increases when demand rises, but firms may also need to reduce their inventory levels to keep up with demand. A weak relationship between cash flow and inventory investment could arise from this. Nonetheless, firms with higher cash flow may afford to stock more inventory, indicating a positive correlation between cash flow and inventory investment. If the magnitudes of these two opposing effects are equivalent, they may cancel each other out, producing a negligible effect.

The *fourth* sub-hypothesis is linked to testing the relation between sales growth and abnormal inventory level. Prior literature had debated the significance and direction of this relation. According to statistical analysis, there is a significant negative relation between sales growth and abnormal inventory level. This is in line with Kolias et al., (2011). This is not in line with other literature suggesting a positive relationship between sales growth and abnormal inventory (Guariglia & Mateut, 2010; Sangalli, 2013). An increase in sales growth by one standard deviation is associated with a decrease in abnormal inventory level by 12.8 percentage. This could be justified as when a firm experiences rapid sales growth, it may struggle to adjust its inventory levels quickly enough to keep up with increasing demand.

The *fifth* sub-hypothesis is associated with testing the relation between sales volatility and abnormal inventory level. According to the statistical results, there is a significant negative relation between sales volatility and abnormal inventory level. This result is different from prior literature (Gaur et al., 2005; Kolias et al., 2011; Yousaf & Dehning, 2023). However, this result could be due to applying on the Egyptian firms and using a prediction model to measure abnormal inventory level rather than using actual inventory to sales or inventory turnover ratio. This implies that an increase in sales volatility by one stand deviation is associated with a decrease in abnormal inventory level by 7.3 percentage.

The *sixth* sub-hypothesis is relevant to testing the relation between gross margin and abnormal inventory level. According to the statistical results, there is a significant negative relation between gross margin and abnormal inventory level. This result is in

conformity with prior literature inventory (Gaur et al., 2005; Kolias et al., 2011; Wu et al., 2019; Yousaf & Dehning, 2023). This result is also contradicted to in prior literature (Wang et al., 2022; Yiu & Wu, 2021). This implies that an increase in gross margin is related to a decrease in abnormal inventory by 72.5 percentage. This shows that firms with high gross margin follows a low abnormal inventory strategy either due to JIT or transaction cost motive.

The seventh sub-hypothesis is affiliated with testing the relation between trade credit and abnormal inventory level. According to the statistical results, there is an insignificant negative relation between trade credit and abnormal inventory level. this is not in line with some prior literature (Afrifa et al., 2021; Afrifa & Gyapong, 2016). Trade credit the firm receives from its own suppliers may have the effect of offsetting the effects of offering trade credit to customers. This mitigating effect may reduce the overall effect on the firm's inventory position.

The *eighth* sub-hypothesis is interlinked with testing the relation between lead time and abnormal inventory level. According to the statistical results, there is an insignificant positive relation between lead time and abnormal inventory level. This is not in line with Hoberg et al., (2017). This could be justified firms normally keep a certain amount of safety stock on hand as a safety measure against unforeseen shifts in supply or demand, including variations in lead times. Safety stock can lessen the effects of lead time adjustments and stop large variations in anomalous inventory levels.

The *ninth* sub-hypothesis is tied to testing the relation between firm size and abnormal inventory level. According to the statistical results, there is a significant positive relation between firm size and abnormal inventory level. This is in line with prior literature (Serrasqueiro & Azevedo, 2016; Celestine et al., 2023; Theodossiou et al., 1996; Tripathi & Kochhar, 2016). This is also not in line with Bustos, (2023). An increase in firm size by one standard deviation results in an increase in abnormal inventory level by 11.4 percentage.

The second hypothesis is related to external environmental determinants that affect abnormal inventory level. It includes four sub-hypotheses. It must be noted that due to multicollinearity inflation is excluded. Therefore, three sub-hypothesis are tested. According to hypothesis testing, results revealed that external determinants have a significant impact on abnormal inventory level. Therefore, the second null hypothesis ($H_{0.2)}$ is rejected. The *first* sub-hypothesis, which is the first external environmental factor, tests the relation between market power and abnormal inventory level. According to the statistical results, there is an insignificant negative relation between market power and abnormal inventory level. This is not in line with Tripathi & Kochhar, (2016). However, this could be justified according to the nature of the Egyptian firms and using a predicted model to measure abnormal inventory level unlike prior literature using actual inventory-to-sales ratio (Hill et al., 2010).

The *second* sub-hypothesis is testing the relation between economic policy uncertainty and abnormal inventory level. Results showed that, there is an insignificant negative relationship between economic policy uncertainty and abnormal inventory level. This is not in line with Serrasqueiro & Azevedo, (2016) who stated that as changes in trade laws, tariffs, and regulations can cause supply chain disruptions and have an effect on the price and availability of components, raw materials, and finished goods. Higher amounts of abnormal inventory can be caused by stock-out, shortages, or imbalances in inventory as a result of these supply chain disruptions. However, the researchers can justify the insignificant relationship between EPU and Abnormal inventory due to including only Egyptian firms that are facing the same economic policy uncertainty circumstances. Therefore, economic policy uncertainty is not significantly related to abnormal inventory level in the current research. However, making a comparative study with other countries might vary this relation.

The *third* sub-hypotheses test price volatility and abnormal inventory level relationship. Results showed that there is an insignificant negative relationship between price volatility and abnormal inventory level. This is not in conformity with Thille, (2006). Higher price volatility may cause firms to maintain higher inventory level as a safety measure against shocks to supply or demand, which would increase the levels of abnormal inventory. On the contrary, high fluctuations in prices might force firms to reduce inventory and make more frequent adjustments to production, which could help them reduce abnormal inventory. Consequently, the overall effect on abnormal inventory may be negligible if these several effects are roughly offsetting one another.

Finally, the third hypothesis is related to testing the impact of environmental factors on abnormal inventory level. According to hypothesis testing, results revealed that environmental factors affect abnormal inventory level since the R-squared is 0.862 which means that the model represents 86.2% of the factors affecting abnormal inventory level at a 1% level of significance. Therefore, the third null hypothesis ($H_{0.3}$) is rejected and the alternative hypothesis that there is a significant relationship between environmental factors and abnormal inventory level is accepted.

5. Conclusion, limitations, and future research

Reaching the optimal inventory level is considered a major challenge. This is true as adopting a conservative inventory strategy could increase the cost of holding inventory and obsolesce of inventory while adopting an aggressive inventory strategy could increase the risk of sales loss and customer dissatisfaction. Therefore, both internal and external environmental determinants affecting abnormal inventory are vital in managerial decisions. This research tests the effect of internal and external environmental determinants on abnormal inventory.

The final sample size included 52 Egyptian firms listed in the EGX100 index from five sectors over 8 years starting from 2016 to 2023. With a total number of observations of 389, the results revealed that firm's size has a significant positive

impact on abnormal inventory. On the opposite, sales growth, sales volatility, financial conditions, gross margin, capital intensity, and economic policy uncertainty have a significant negative impact on abnormal inventory. In addition to that cash flow, lead time, and trade credit, market power, and price volatility are not significantly related to abnormal inventory. Inflation is excluded due to multicollinearity with price volatility which implies higher R-squared

The current research is considered one of the pioneer researches to highlight the environmental determinants' effect on abnormal inventory level. Prior literature usually considers inventory management as a static level ignoring that inventory management could implicitly refer to conservative and aggressive inventory strategies and might be affected by different environmental factors. Moreover, little literature tested the effect of industry-specific and macroeconomic factors on abnormal inventory. This research could provide some explanations for managerial decisions regarding abnormal inventory level. Practically, this research could help managers adopt a suitable inventory strategy in light of the contingent factors faced by each firm. Managers might use this research as a guidance for their managerial decisions regarding inventory level.

The research is limited by the sample size as it is applied on EGX100 only, for future research, a comparative study might be conducted to compare the results among various countries. Additionally, the authors use only secondary data. Therefore, using primary data might be suggested to include different managers' perceptions. Moreover, this research is applied over a period of 8 years. However, applying it quarterly might be useful to test the sales surprise effect on abnormal inventory.

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