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# Top Manager Gender Differences in Inventory Management Under Business Obstacles

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## ABSTRACT

While the effect of gender on firm performance has been widely studied, its impact on operational policies remains underexplored. We examine the association between top managers' gender and inventory policy among small and medium-sized enterprises (SMEs), where top managers play a central role in policy formulation and execution. We find that female-led firms hold lower levels of industry-adjusted inventory than male-led firms, with stronger effects in manufacturing and micro-sized firms. We further show that this relationship is context dependent: female-led firms maintain leaner inventories when business obstacles heighten perceived overstocking and liquidity risk, but increase inventories when obstacles threaten operational continuity. Repeating the analysis using female ownership as the key variable yields weaker effects, supporting the role of the top manager in shaping operational policy. We also document an inverted *U*-shaped relationship between inventory and firm performance; most firms operate below the performance-maximizing inventory level, and female-led firms tend to remain further from this optimum, contributing to gender differences in firm performance.

## 1 | Introduction

The top manager (TM) refers to the highest-ranking manager in a company. TMs are responsible for overseeing the entire organization and for developing firm-wide goals, strategic plans, and policies. While functional executives, such as chief functional officers, are typically appointed to manage specific areas, a TM may also be personally associated with functional policies, a tendency that has been argued to increase over time (Quigley and Hambrick 2015). This influence is particularly pronounced in private small and medium-sized enterprises (SMEs), where TMs often face fewer constraints from financial markets compared to their counterparts in large public firms. Due to flatter organizational structures and limited middle management, TMs in SMEs frequently play an active role in both strategic and operational decision-making (Perrin and Weill 2023).

Committed leadership is a fundamental requirement for the successful implementation of major operational strategies such as just-in-time, lean production, total quality management, and corporate social responsibility (Kaynak and Hartley 2006). Decisions related to buffer policies, working-capital intensity, and the adoption of lean versus buffer-heavy strategies reflect firm-wide operational policies that are closely tied to risk tolerance, liquidity management, and responsiveness to uncertainty. Prior research on lean transformation emphasizes that such policy-level decisions cannot be effectively delegated to a single operational executive but instead require coordinated leadership by the senior management team, led by the CEO (Löfving et al. 2021). This view aligns with the servant leadership model exemplified by Toyota, in which top managers position themselves at the bottom of an inverted organizational pyramid to enable and sustain operational excellence (Spears

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and Lawrence 2016). Accordingly, even nonoperational attributes of TMs, such as political ties (Shen et al. 2023) or network relationships (Falcone et al. 2022), can be associated with firms' operational strategies.

The upper echelons theory (UET) (Hambrick and Mason 1984) has emphasized that managers' background and individual characteristics, such as gender, affect corporate decisions and outcomes. Relying on UET, a substantial body of research shows that women in senior leadership roles tend to adopt more democratic and participatory leadership styles and place greater emphasis on the public good compared to their male counterparts (Eagly et al. 2003). Illustrative evidence from practice, such as the lean transformation described in the book named *Steel Toes and Stiletos*, highlights the potential for women manufacturing leaders to drive significant operational improvements (Karels and Miller 2021). However, despite growing interest in leadership diversity, the role of executive gender in shaping operational policy choices, particularly in SMEs and during periods of transformation or disruption, remains underexplored (Wang et al. 2011).

Inventory policy represents a central component of working capital management and operational strategy and reflects a firm's tolerance for risk and uncertainty. Lean inventory strategies emphasize cost efficiency and capital discipline but increase exposure to supply disruptions and demand volatility, whereas buffer-heavy strategies enhance resilience at the cost of higher holding, coordination, and obsolescence costs (Barker et al. 2022). Because these trade-offs involve firm-wide risk considerations and long-term performance implications, inventory policy choices are typically shaped at the top of the organization, particularly in SMEs where managerial discretion is high (Quigley and Hambrick 2015). In SMEs, where the CEO can also be the owner, such involvement in inventory and supplier selection policies is well-documented in both developed and developing economies (Loury-Okoumba and Mafini 2021). Moreover, CEO compensation is linked to inventory-related performance outcomes such as inventory turnover and net working capital ratios (Gong et al. 2024), which may incentivize CEOs to allow inventory to fall below levels justified by standard cost-benefit trade-offs (Tonello and Reda 2015).

This study examines the association between top manager gender and firms' inventory policies in private SMEs. Despite extensive literature on gender differences in leadership style, risk preferences, and firm performance (Eagly et al. 2003), the gender and inventory relationship is limited to anecdotal evidence and single decision-maker experimental work in the literature (e.g., de Véricourt et al. 2013; Becker-Peth et al. 2018). By examining inventory policies across a large sample of SMEs, this study extends the upper echelons framework into the operations management literature and investigates the association between the gender of TM and the inventory policy pursued by the firm.

Gender differences in management are often reported to be context-dependent (Post and Byron 2015). Because the extent to which individual managerial characteristics influence firm decisions depends on external constraints and uncertainty,

the business environment constitutes a critical contextual factor shaping managerial discretion. The business environment is the "policy, institutional and regulatory environment in which firms operate" (Kinda et al. 2009). Also called the business or investment climate, the business environment is mostly determined by long-term governmental and political attitudes and policies toward companies, their funding for labor unions, and their financial stability. The business climate describes various infrastructure (technology, transportation, land, public services), financial, political, security (lack of corruption and crime), and regulation (competition, labor, taxes) variables (Dethier et al. 2011). The business environment varies significantly between developed and less developed countries, as well as between different regions of a country (Brennan et al. 2022).

The effect of the business environment on the growth, productivity, profit/revenue/output, and foreign direct investment of a firm has been considered in the literature (Dethier et al. 2011). However, most studies remain at the stage of overall firm performance without deconstructing this relationship at the operational policy level (Spring et al. 2017). Both the availability and quality of business infrastructure are important in all stages of the supply chain to ensure competitiveness in terms of responsiveness and/or efficiency. Obstacles in infrastructure can greatly affect the cost of infrastructure usage, as well as the time required to access the infrastructure. In addition to obstacles in infrastructure, business environment variables that directly affect a firm's operations include regulations and bureaucracy (Jiang et al. 2024). In particular, anecdotal evidence indicates that changes in certain variables in the business environment can lead to direct changes in inventory levels. For example, each dollar of investment in highway improvement is shown to decline firm inventory levels by 7% in the US (Shirley and Winston 2004) and by 2% in China (Li and Li 2013).

By examining whether perceived business obstacles moderate the association between TM gender and firm's inventory policy, this study offers a context-sensitive understanding of gendered decision-making in operations. We investigate how gender diversity in leadership interacts with external constraints to shape inventory strategies, offering practical insights for firms operating in volatile or resource-constrained settings. We used SME firm-level data to investigate whether there is an association between top manager gender and inventory policy moderated by perceived obstacles in the firm's business environment.

To our knowledge, our study is the first investigation of the relationship between the gender of the TM and the aggregate level of the firm's inventory using secondary data. We used a firm-level data sample of more than 31,000 private firms in 83 countries obtained through the World Bank Enterprise Surveys. Moreover, it is the first attempt to understand whether the business environment affects the executive gender and inventory policy relationship. The data set allows us to account for firm-level differences in perceived business obstacles to investigate the moderating effects of the business environment, which cannot be measured using country-level business environment rankings often used in past studies, such as World Bank's Doing Business data, foreign direct investment data from Eurostat, and Global Competitiveness Report. Thus, we can observe unique

effects of the business environment that may depend on the size, location, and industry of the firm.

Our analysis shows a statistically significant difference in inventory levels according to the TM gender, where firms managed by female top managers hold lower levels of industry-adjusted inventories. Results also indicate that firms with female TMs maintain higher or lower inventory levels than those with male TMs when faced with different types of obstacles in the business environment. In particular, when transportation represents a higher obstacle to a firm's operations, female-led firms tend to keep fewer inventories than male-led firms. However, under greater perceived political instability or obstacles to access finance, companies with female TMs significantly increase inventory levels. We also found that the small-sized firms with female TMs are more sensitive to obstacles in access to finance, whereas in the medium category, firms with female TMs are more sensitive to obstacles in tax rates compared to male-led firms. When we repeat our analyses with the percentage of female ownership to differentiate between ownership and decision-making authority, we found that the gender distribution of the ownership has also an impact on the inventory policies pursued, but weaker compared to top manager effect.

To examine the performance implications of gender-based differences in inventory management, we test the inventory level and firm performance relationship with our sample. Our analysis confirms the concave relationship between inventory levels and firm performance documented by prior literature. On the other hand, our further analysis reveals that most firms in our sample operate on the increasing segment of this curve. Importantly, female-led firms tend to maintain inventory levels that deviate more substantially from the estimated performance-maximizing threshold compared to their male-led counterparts. This misalignment may partially account for gender-related differentials in firm performance outcomes often discussed in management literature (Adams and Ferreira 2009).

The contribution of our study is multifold. Our study mainly contributes to the need in explaining the relationship between demographic factors of the managers and operational performance using a large dataset, which is underlined as a significant gap in operations management literature (Roels and Staats 2021). Zinn et al. (2018) stated the importance of understanding whether there are unique skills of women that would benefit supply chain decision-making.

Our study extends research on gender differences in leadership within the upper echelons framework by shifting attention from aggregate financial outcomes to underlying functional strategies. While prior UET-based studies have primarily examined firm-level financial performance, this study investigates inventory policy as a key operational strategy through which top manager gender may influence organizational outcomes.

Third, using firm-level data, our study demonstrates microlevel support for the relationship between the business environment and inventory levels. Dethier et al. (2011) highlighted the need

“to develop a better understanding of the link between firm choices and the business climate”. Our study fills this research gap by investigating the role of the business environment in controlling firm-level inventory decisions. We show significant increasing effects of business obstacles on inventory levels. Thus, investments to improve the business environment of a country, such as infrastructure, regulations, financial environment, and social stability, would increase the efficiency of the firms' inventory, improving the competitiveness of these firms.

The remainder of the study is organized as follows. In Section 2, we review the literature and present our hypotheses. In Section 3, we present details about our sample and the variables used in the study. We discuss our estimation model and results in Section 4. In Section 5, we report several robustness checks to alleviate endogeneity and the effects of other possible variables; regional fixed effects, gross margin, and ownership gender distribution. We discuss the theoretical and managerial implications of the findings in Section 6 and the contributions of the study, its limitations, and directions for future research in Section 7.

## 2 | Related Research and Hypotheses Development

Although our research question has not been directly examined in the literature, our study relates to four distinct streams of prior research. The first stream investigates gender differences in management and behavioral economics. The second stream studies the effect of gender, particularly in operational decision-making, which has been very limited. The third stream investigates the direct and moderating effects of business environment variables on firm operations and performance. Finally, the fourth stream regards the implications of inventory policies on firm performance.

### 2.1 | Gender Differences in Management and Behavioral Economics

The upper echelons theory (UET) (Hambrick and Mason 1984) has emphasized that managers' background and individual characteristics affect corporate decisions and outcomes. The UET theory is based on the fact that given bounded rationality, managers have difficulty processing all the information coming from the external and internal environments. As a result, managers tend to bias their decisions with their backgrounds, personalities, values, preferences, and prior experiences, which act as cognitive filters, shaping how managers perceive and interpret information and ultimately leading to different strategic choices. Numerous studies have adopted the UET to examine the relationship between senior manager demographics and organizational outcomes, such as innovation (Wu et al. 2021), R&D spending (Barker and Mueller 2002), firm performance (Adams and Ferreira 2009), and environmental practices (Kuzey et al. 2022).

Following the UET, a growing body of research has shown differences in attitudes and leadership styles between female and male executives. Female managers have been found to be more

democratic and participatory and promote the public good than their male counterparts (Eagly et al. 2003). They are also more transformational leaders as they motivate followers and better endorse social values (Schwartz and Rubel 2005).

In behavioral economics research, a substantial body of literature has examined gender differences in risk preferences and overconfidence. Due to their biological and psychological differences, men and women generally have different risk preferences and willingness to compete (Byrnes et al. 1999). The seminal work by Croson and Gneezy (2009) provides a comprehensive review of gender differences across various economic behaviors. Women have been shown to be more risk-averse than men in financial (Jianakoplos and Bernasek 1998) and investment (Powell and Ansic 1997) decision making, while expertise can mitigate gender differences to some extent. The higher risk propensity of men than women has roots in women reporting greater probabilities of negative consequences from engaging in risky behaviors and also enjoying the rewards of these behaviors less than men (Harris et al. 2006). Moreover, female executives' reluctance to choose risky strategies could be due to their consideration of others in their decision-making, called other-orientation (Shropshire et al. 2021).

On the other hand, in decision areas in which risk taking is a more nuanced part of the job, such as entrepreneurship, gender differences in risk-taking propensity might not be significant (Masters and Meier 1988). Moreover, when high-performing women are considered, not much evidence has been reported of more risk averse decision-making of women than of men (Maxfield et al. 2010). Filippin and Crosetto (2016) conducted meta-analyses of scholarly work on the subject and concluded that factors such as culture and task details may contribute to observations of such differences.

Although the results have been mixed on the risk attitudes of women and men, the consequences of different risk propensities have also been questioned. Female executives are more in line with the interests of shareholders and use short-term debt over long-term debt (Datta et al. 2021), prefer lower leverage and less volatile earnings, and maintain a lower debt ratio in their firms (Martín-Ugedo et al. 2018). Female investors tend to be more conservative in their investments and hold smaller proportions of risky assets than men (Jianakoplos and Bernasek 1998). In addition to being more risk averse, women are found to be more loss averse than men (Wang and Webster 2009). Following prospect theory, loss aversion arises when one's utility function is steeper for losses than for gains, where loss and gain are defined according to a reference point (Uppari and Hasija 2018).

Another important gender-based personal trait related to managerial decisions is overconfidence, and men have been shown to be more overconfident than women (Barber and Odean 2001). Overconfidence is defined as individuals' overestimation of their ability to predict the future or underestimation of the variation of random events. Bengtsson et al. (2005) demonstrate that men show significantly higher overconfidence in financial decision-making. Male executives who overestimate net present values have been reported to undertake more acquisitions, and these acquisitions have lower announcement returns than those made by female executive firms (Huang and Kisgen 2013).

Furthermore, women and men behave differently in terms of social preference. Andreoni and Petrie (2008) show that gender influences outcomes in public goods games due to social expectations. The study finds that attractive individuals earn more when contributions are hidden as they are expected to be more cooperative. However, when information on contributions is visible, these advantages disappear. Also, drawing from Falk and Fischbacher (2006), women are often more responsive to social and relational cues, making them more sensitive to perceived intentions and more likely to engage in positive reciprocity, such as cooperation and reward. Men, in contrast, may be more inclined toward negative reciprocity, such as punishment in competitive settings (Niederle and Vesterlund 2007).

## 2.2 | Gender Effect in Operational Decision Making

Roels and Staats (2021) highlight a persistent gap in the operations management literature in explaining how demographic characteristics of decision makers translate into operational performance. Within this literature, two broad streams examine gender-related differences: people-centric operations, which study how human characteristics affect operational processes, and behavioral operations, which analyze how individual behavioral traits influence operational decision-making. While both streams provide valuable insights, they have largely focused on product-level or task-level decisions rather than firm-level operational policies.

A related body of research in supply chain management examines gender diversity in decision-making roles and documents systematic differences in collaboration, responsiveness, and social responsibility. For example, women are found to be more collaborative in supply chain relationships (Ma et al. 2021), to enhance socially responsible supplier selection (Ruel and Fritz 2021), and to influence product recall behavior and environmental outcomes through board representation (Wowak et al. 2021; Konadu et al. 2022). However, this literature does not directly address how top manager gender affects firm-level inventory policies, which involve explicit trade-offs between risk, capital allocation, and performance.

A substantial stream of behavioral operations management directly models how decision makers' risk preferences shape inventory decisions. In the canonical newsvendor framework, analytical studies consistently show that risk-averse decision makers order less inventory than risk-neutral ones under standard assumptions (Eeckhoudt et al. 1995; Agrawal and Seshadri 2000; Song et al. 2021; Giri 2011). These results extend to multiperiod settings with inventory carryover (Bouloureshef and Holt 2025) and to loss-averse preferences under certain cost structures (Wang and Webster 2009; Herweg 2013). Experimental evidence corroborates these predictions, demonstrating that individuals with higher risk aversion place significantly lower orders and that female subjects often order less than male subjects under comparable conditions (Becker-Peth et al. 2018), although outcomes may vary with profit margins (low vs. high) of the product tested (de Véricourt et al. 2013; Villa and Castañeda 2020).

While this behavioral operations literature provides clear predictions at the product level, our study examines inventory decisions at the firm level. To bridge this gap, we draw on upper echelons theory and related finance research, which explicitly links executive characteristics to firm-level strategic and financial choices. Prior studies grounded in UET show that female executives tend to adopt more conservative and risk-averse strategies, particularly in financing decisions in strategic decision-making (Byrnes et al. 1999; Harris et al. 2006; Shropshire et al. 2021). Firms led by female CEOs consistently exhibit lower leverage and reduced reliance on debt financing (Martín-Ugedo et al. 2018; Lo et al. 2023), with risk aversion identified as the underlying mechanism.

Inventory policy is closely tied to these financial decisions through working capital management. Evidence from firm-level studies indicates that higher leverage is associated with higher working capital and inventory holdings, as firms seek to protect cash flows and debt repayment capacity (Deshpande 2023). Consequently, conservative, low-leverage strategies—such as those pursued by female executives—are likely to be associated with lower working capital investment and, by extension, lower inventory levels.

This interpretation is reinforced by research on liquidity management, which shows that female executives tend to favor liquid assets such as cash over illiquid forms of working capital (Opler et al. 1999). Studies document higher cash holdings and improved liquidity under female leadership (Sah et al. 2022), consistent with a preference for financial flexibility and capital preservation. When inventory is framed primarily as an illiquid and potentially risky financial commitment—due to holding costs, obsolescence risk, and demand mismatch—risk-averse managerial behavior can translate into leaner inventory positions, particularly in SMEs where capital constraints are salient.

Upper echelons theory provides a unifying explanation for this pattern by emphasizing that executives' demographic characteristics shape how strategic trade-offs are perceived and resolved (Hambrick and Mason 1984). Importantly, this perspective does not contradict the buffering logic emphasized in supply chain management. Rather, it highlights that the effect of risk aversion on inventory depends on whether inventory is perceived primarily as an operational buffer or as a source of financial exposure. In firm-level settings where working capital considerations dominate, greater managerial risk aversion may lead to lower aggregate inventory holdings.

Accordingly, we hypothesize:

**H1.** *Firms with female TMs operate with lower inventory levels relative to firms with male TMs.*

### 2.3 | Business Environment: Direct and Moderating Effects

According to Berger (2013), there are “rich and diverse set of complementary capabilities in the industrial ecosystem: suppliers, trade associations, industrial collective research consortia,

industrial research centers, university-industry collaborations, technical advisory committees”. Without understanding the richness of the resources and limitations within the specific industrial sector of the country, it may be an incomplete evaluation of firms' operations.

Through its impact on company operations, the business environment affects country-wide economic activity, which finally determines firm growth (Beck et al. 2005), firm productivity (Dollar et al. 2005), firm profit/revenue/output (Commander and Svejnar 2011), and foreign direct investment (Corcoran and Gillanders 2015). The literature in general provides evidence that, by inspiring greater productivity and investment, a favorable business environment promotes growth. Investment can be discouraged in a poor business environment, and businesses may need to overinvest to survive. Dethier et al. (2011) provided a comprehensive review of previous studies on the association between the business environment and firm performance. We discuss the effects of the business environment on firm operations using the four categories of business environment introduced by Nam et al. (2016): infrastructure, labor and regulation, finance, and political stability.

There are large variations in the availability and quality of public infrastructure, such as electricity, the Internet, and transportation, between countries, regions, and firms of different sizes. The ability of a firm to allocate its resources to more productive uses and invest efficiently depends on the availability of the infrastructure, which is one of the most significant business environment variables on the firm productivity. Obstacles in infrastructure have been shown to have negative impacts on exports and production (Dollar et al. 2005). In particular, small firms (Aterido et al. 2007) and firms in poor and rapidly growing countries are more affected by infrastructure deficiencies (Escribano et al. 2010). Lai (2006) focused on transportation infrastructure and shows empirical support for their substitution hypothesis, which claims that private firms' inventory level substitutes for public infrastructure.

Carlin et al. (2006) demonstrated that most critical market barriers in all countries are bureaucratic, such as tax rates and administration, and macroeconomic and political instability. Atabek et al. (2016) suggested that changes in regulations in the manufacturing industry are highly likely to facilitate productivity and job growth. Gelb et al. (2011) stated that infrastructure and access to finance are the most fundamental constraints for businesses in low-income countries, but governance-related constraints and labor regulations become more constraining in higher-income countries. Although consistent implementation of regulations has a positive impact on firm growth, legal obstacles negatively affect the growth rates of medium-sized and especially small firms (Beck et al. 2005).

Acquiring financial funding is necessary for firms to grow their businesses and achieve economies of scale, start projects in new markets, and embrace new technologies. The obstacles observed in accessing finance have a negative effect on firm performance and growth (Ayyagari et al. 2008). For example, obtaining credit from banks can help a firm invest in new products or capacity, which leads to firm growth. Qureshi et al. (2015) showed that countries with fewer obstacles to

access to finance exhibited stronger resilience and recovery from the global financial crisis. The size of the firm is important to mediate the effect of financial constraints, where Beck et al. (2005) reported that small firms have much greater financial obstacles than larger firms.

Political stability is the likelihood that the government will be credibly committed to policies and rules set. Uncertainty may reduce or increase corporate investments, depending on whether it is approached by a wait-and-see policy until uncertainty is resolved or growth potential, as uncertainty may have the potential to lead to higher than normal outcomes (Perrin and Weill 2023). In politically unstable environments, where government policies frequently change, creating a high level of uncertainty, prudent inventory management strategies can mitigate the risk of supply chain disruptions caused by sudden changes in regulations (Fan et al. 2022). Political instability is a major concern especially for small and exporting firms, because small firms may have less special treatment from policy makers (Matta et al. 2018).

To summarize, first, the literature reports significant negative effects of business obstacles on firm growth and productivity. On the other hand, there is evidence in the operations management literature for the decreasing effect of sales growth rate on a firm's inventory levels (Rumyantsev and Netessine 2007). Thus, one would expect that business obstacles faced by a firm would decrease the firm's sales growth, causing increased inventory levels. Second, both the extensive literature and interviews conducted with practitioners report increased inventory levels as a strong resilience strategy to mitigate supply, demand, and control risks. Risks may arise as a result of catastrophic events, such as natural disasters, as well as regulatory, legal, political, and infrastructure risks. Third, business environment variables impact both firms and consumers in an economy. While economic and political instability can have direct effects, infrastructure, labor, and regulation, and financial constraints may also have indirect effects on consumption patterns through increasing costs of goods and services, finally leading to increased demand variation, and thus inventory levels. In conclusion, we expect firms to keep higher inventory levels when prone to higher obstacles in the business environment.

## **H2.** *Under higher levels of business obstacles, firms operate with higher levels of inventory.*

The relationship between top manager gender and inventory policy is unlikely to be uniform across business environments. As emphasized in the management and behavioral economics literatures, gender differences in risk attitudes, loss aversion, and overconfidence are inherently context dependent. Upper echelons theory further suggests that under conditions of heightened environmental uncertainty, executive decision-making becomes less driven by purely rational optimization and more reflective of individual cognitive frames and demographic characteristics such as gender (Hambrick et al. 2005). Ma and Aloysius (2024) show that increased ambiguity results in increased decision biases. Accordingly, understanding how female top managers interpret and respond to different types of business obstacles is central to explaining heterogeneity in inventory policies.

Drawing on contingency theory and the resource-based view, we argue that the value and role of inventory as a strategic resource depend on environmental conditions and cannot be assessed independently of context (Sousa and Voss 2008). Business environment obstacles, such as infrastructure constraints, regulatory burdens, financial frictions, or political instability, typically introduce uncertainty that affects both demand- and supply-side conditions simultaneously. As a result, inventory decisions are shaped by multiple, potentially competing considerations rather than a single dominant uncertainty channel.

Behavioral operations research highlights that uncertainty influences inventory decisions through distinct behavioral biases. Increased demand uncertainty has been shown to induce a pull-to-center bias, leading decision makers to adopt more conservative inventory positions, whereas increased supply uncertainty may generate push-from-center or diversification behaviors that result in more extreme inventory choices. Importantly, recent evidence demonstrates that the presence of both supply- and demand-side uncertainty has a more nuanced effect on decision biases than does either type of uncertainty in isolation. Behavioral tendencies commonly associated with one form of uncertainty can be activated or attenuated by the other, and their interaction can lead to nonobvious net effects on inventory decisions (Bendoly et al. 2022). Because business environment obstacles typically affect both sides of the market, it is unclear ex ante which behavioral response will dominate in any given context.

When business obstacles are interpreted primarily as amplifying demand volatility, such as political instability leading to market distress, inventory is more likely to be perceived as an illiquid and potentially loss-generating investment. In such contexts, risk-averse managers may prioritize capital preservation and liquidity, favoring leaner inventory positions. Consistent with this view, studies document that female executives tend to manage liquidity more conservatively, maintain higher cash holdings, and reduce risky investment during periods of economic uncertainty (Sah et al. 2022; Shropshire et al. 2021; Perrin and Weill 2023). As a result, when obstacles are interpreted as primarily affecting demand conditions, they may reinforce the negative association between female leadership and inventory levels.

By contrast, when obstacles are interpreted primarily as increasing supply-side disruption risk, such as political instability leading to supply disruptions, the dominant risk shifts from financial loss to operational failure. Under these conditions, inventory is more likely to be perceived as a protective buffer that supports resilience and continuity. Consistent with the resource-based view and organizational slack theory, managers may intentionally accumulate slack resources to safeguard operations in volatile environments (Barney 1991; Bourgeois III 1981). Even risk-averse decision-makers may therefore increase inventory to mitigate understocking risk when continuity is threatened.

From an upper echelons perspective, the resolution of these competing behavioral forces depends on how top managers cognitively frame and prioritize risks. Prior research suggests that female executives tend to be more risk- and loss-averse and more sensitive to downside exposure than their male counterparts (Weber et al. 2002; Wang and Webster 2009). When confronted

with obstacle-induced uncertainty that simultaneously raises concerns about overstocking risk, liquidity exposure, and operational continuity, female and male top managers may emphasize different risks and therefore adopt different inventory responses. As a result, the same business obstacle may lead to divergent inventory adjustments depending on the gender of the top manager, reflecting differences in how uncertainty is perceived and managed rather than differences in the objective nature of the obstacle itself.

Taken together, these arguments suggest that business environment obstacles moderate the relationship between top manager gender and inventory policy in a context-dependent manner. Because obstacles introduce joint supply- and demand-side uncertainty and activate multiple behavioral biases simultaneously, the direction and magnitude of the moderating effect cannot be determined *ex ante* and depend on which risks dominate managerial attention. Accordingly, we develop competing hypotheses regarding the direction of the moderating effect.

**H3a.** *The negative relationship between the female TM and inventory levels is weakened under higher levels of business obstacles.*

**H3b.** *The negative relationship between the female TM and inventory levels is strengthened under higher levels of business obstacles.*

## 2.4 | The Relationship Between Inventory Level and Firm Performance

Although our main focus is on the relationship between the gender of the top management and the inventory levels held by the firm, the implications of this possible relationship raise a follow-up question, which has also been the subject of recent studies in various industries and using different performance measures (Modi and Mishra 2011; Eroglu and Hofer 2011; Bendig et al. 2017; Çömez-Dolgan et al. 2025). Inventories are crucial assets for most firms, especially in the manufacturing, retail, and wholesale industries. Efficient inventory management can improve operational efficiency through cost reduction and increased sales. Given the often conflicting objectives of lowering costs and increasing customer service levels, empirical findings in the literature have been mixed on the impact of inventory levels on firm performance.

A growing body of empirical research has explored the relationship between inventory levels and firm performance. Assets tied up in inventory may harm performance, as inventories are nonliquid and prone to deterioration. Moreover, in cases of weak firm performance, excess inventory can lead to business failure, including bankruptcy. Operating with lower inventory levels is often considered beneficial, as reducing excess resources can generate substantial cost savings that can be redirected to other areas. Numerous studies agree that efficient resource use improves firm performance, as measured by return on assets (ROA) (Modi and Mishra 2011), return on sales (ROS) (Jayaram et al. 2008), stock returns (Alan et al. 2014), gross profit (Capkun et al. 2009), firm survival probability (Patel et al. 2017), and

attractiveness to institutional investors, particularly in industries facing high demand uncertainty (Neukirchen 2021).

In the past two decades, increasingly complex supply chains and frequent market disruptions have shifted focus to design-for-resilience, which mitigates disruption impacts using slack resources, contingency planning, and flexible supply chain design. However, holding less slack can lead to revenue losses, damage to customer goodwill, late fees, and expediting costs, ultimately resulting in financial penalties (Barker et al. 2022). For example, Toyota experienced significant supply shortages following the 2011 Japan earthquake, attributed to its just-in-time strategy (Boudette 2011).

More recently, several studies have shown that the relationship between inventory levels and firm performance follows an inverted U-shape. Financial performance initially improves with increasing inventory, up to a turning point beyond which performance declines. Eroglu and Hofer (2011), analyzing U.S. manufacturing firms, demonstrate that this concave relationship varies significantly across industries. Subsequent research confirms this pattern in relation to firm equity (Modi and Mishra 2011), credit ratings (Bendig et al. 2017), and financial distress probability (Çömez-Dolgan et al. 2025), particularly in highly competitive and uncertain environments (Chuang et al. 2019).

In summary, both practitioners and scholars emphasize the trade-off between efficiency and flexibility when determining resource levels. Our hypotheses are based on the latest literature reporting an inverted U-shaped relationship between inventory levels and firm performance, highlighting low performance at extreme inventory levels, such as very high or zero-inventory strategies.

**H4.** *The inventory level of a firm has an inverted U-shaped relationship with firm performance.*

## 3 | Data Sample and Research Model

### 3.1 | World Bank Enterprise Surveys Dataset

The World Bank Enterprise Surveys (WBES) are collections of firm-level surveys of a representative sample of firms from the manufacturing and service industries, mainly from developing countries. The WB has been conducting firm-level surveys since 1990 and using standardized surveys among 151 countries since 2005–2006. Registered firms with five or more employees that are not 100% government-owned can participate in surveys. Stratified random sampling is followed according to the size of the firm, the industry, and the geographic region within each country. Surveys include questions seeking both qualitative and quantitative information at the firm level, as well as a broad range of measures of the business environment, which are perceptions of business decision makers about the obstacles to firm development. Raw datasets, aggregate datasets, and panel datasets are publicly available to researchers.

The survey is answered by business owners and TMs often face-to-face. There is a single respondent, but the survey respondent

can call company accountants and human resource managers to answer questions related to sales and labor. The presence of a key informant as one of the top-level executives is important because the survey has opinion-based questions that seek the actual opinion of the respondent, as well as questions regarding the firm's overall operations and performance.

## 3.2 | Variables

### 3.2.1 | Dependent Variable: Inventory

The survey question that is used to obtain the inventory level of a firm is "At the present time, when this establishment receives delivery of its most important input, on average, how many days of inventory, measured in days of production, does this establishment keep?". Inventory is reported as days of inventory,  $DI$ , which is a normalized inventory level for each firm wrt its sales.

While days of inventory or inventory turnover ratio (365/days of inventory) are used quite often in the literature (Marzolf et al. 2024), the inventory practices actually differ substantially across industries, necessitating appropriate controls for industry-specific effects. For this purpose, we adopt a parsimonious normalization approach. We define abnormal inventory as in Chen et al. (2005), denoted by  $AbI$  for each firm-year observation as the standardized deviation of a firm's inventory from its industry mean:

$$AbI_{it} = \frac{DI_{it} - \mu(DI)_{s(i)t}}{\sigma(DI)_{s(i)t}}$$

Here,  $DI_{it}$  denotes the days of inventory of firm  $i$  in year  $t$ , as directly reported in the WBES. The terms  $\mu(DI)_{s(i)t}$  and  $\sigma(DI)_{s(i)t}$  represent, respectively, the mean value and the standard deviation of days of inventory for industry  $s(i)$  of firm  $i$  in year  $t$ , calculated using all firms in the sample that share the same two-digit ISIC industry code. The WBES employs ISIC codes to define industrial classifications. Although, in principle, it would be desirable to compute  $AbI_{it}$  at the country–industry–year level, the cross-country nature of the dataset implies that the number of observations in some country–industry–year cells is too small to reliably estimate the standard deviation. Accordingly, the normalization is performed at the industry–year level across countries. A positive value of  $AbI_{it}$  indicates that the firm  $i$  holds higher inventory level than the industry average in year  $t$ , whereas a negative value reflects relatively leaner inventory holdings compared to industry peers.

### 3.2.2 | Firm Performance

Firm performance is typically measured using financial indicators such as profit, revenue, ROI, ROE, earnings per share, and Tobin's  $q$ , due to their objectivity and simplicity. However, nonfinancial metrics, such as sales growth, market share, labor productivity (sales per employee), customer satisfaction, and environmental outcomes, offer a broader perspective and are also widely used to assess business performance (Nyeadi et al. 2021). Because the WBES dataset lacks sufficient information to compute standard financial indicators, studies

using WBES data rely on nonfinancial proxies. These include sales growth (Nyeadi et al. 2021; Ali and Shabir 2017), labor productivity (Ali and Shabir 2017; Lemma et al. 2023; Jiang et al. 2024), employment growth, and capacity utilization (Ali and Shabir 2017).

Following the WBES-based literature, we proxy firm performance using the natural logarithm of annual total sales revenue divided by the number of permanent full-time employees, which we denote as  $\ln(\text{Labor Prod})$ . All monetary values in the WBES are reported in local currency, so we converted to constant 2010 U.S. dollars using annual average exchange rates and Consumer Price Indices (CPIs) obtained from the World Bank's World Development Indicators database to ensure cross-country comparability.

To assess robustness, we repeat our analyses using gross margin as a proxy for firm performance and obtain qualitatively similar results, which is discussed in Section 4.

## 3.3 | Independent Variables

### 3.3.1 | FemaleTM

A dichotomous question classifies the gender of a firm's TM in the survey; 1 denotes a female TM and 0 a male. TM refers to the highest ranking manager or CEO of the establishment, who may or may not be the owner of the firm. The survey has information on the TM and the owner(s), but not on the general top management team.

### 3.3.2 | Business Environment Variables

WBES measure firms' perceptions of the business environment they are working in using 16 variables: Telecommunications, access to finance, access to land, business licensing/permits, corruption, courts, crime/theft/disorder, customs/trade regulations, electricity, inadequately educated workforce, labor regulations, political instability, practices of competitors, tax administration, tax rates, and transportation. For each variable, respondents are asked "to what degree *this variable* is an obstacle to the current operations of this establishment?" The response is on a 5-point scale from 0 = "No obstacle" to 4 = "Very Severe Obstacle".

The responses to these 16 questions can be highly correlated, so including all together can result in multicollinearity (Véganzonès-Varoudakis and Nguyen 2018; Dethier et al. 2011). Thus, researchers generally group these variables into categories and use either a combined scale or one variable from each category. Commander and Svejnar (2011) noted that generally it does not matter which variable is used to represent a category. Using factor analysis, Nam et al. (2016) proposed four categories: Infrastructure, labor and regulation, finance, and social stability.

In this paper, those variables are selected to capture aspects of the business environment that are related to the inventory management of a firm after performing multicollinearity checks. For example, initial correlation tests resulted in high positive correlation

between obstacles in transportation and customs regulations, thus, one of them is excluded. We used six business environment variables that fall into four categories introduced by Nam et al. (2016): Transportation, land (Infrastructure); labor regulations and tax rates (Labor and regulation); access to finance (Finance); political instability (Social stability). In Section 3.3, statistical tests are conducted to ensure that there is no multicollinearity among these variables in the data sample used.

### 3.4 | Control Variables

We included control variables that have been shown to be related to TM effects and inventory levels in the literature.

#### 3.4.1 | TM Experience

The years of experience of the TM are included to control for the human capital. The experience of a TM can bring important skills into the management of the firm and thus can positively affect the productivity and growth of the firm (Islam et al. 2018). Experienced TMs may have the necessary skills to deal with regulations and official requirements, so that their firm is less likely to perceive obstacles in these operations.

#### 3.4.2 | Firm Age

Firm age is obtained by taking the difference between the year of survey and the year the firm started operating. We used firm age to control for firm-level experience. Islam et al. (2018) showed a positive association between age and productivity.

#### 3.4.3 | Firm Size

Firm size has impacts on firm operations through economies of scale. A larger firm benefits from economies of scale and accumulates lower inventory levels (Rumyantsev and Netessine 2007). Here, we proxy firm size by the logarithmic function of the number of permanent full-time individuals working in the firm. We also used firm size dummies to segment the data according to size and analyze the gender effect of TM in each segment separately.

#### 3.4.4 | Sales Growth

Inventory levels are dynamic in the short and long term. A firm decides on its inventory policy to meet changes in future demand. Thus, a firm that observes sales growth increases its inventory to cope with the expected increase in demand. However, increasing sales may decrease inventory if it does not hedge against uncertain future demand. Rumyantsev and Netessine (2007) found support for the latter statement and showed a negative effect of sales growth on inventory levels. We calculated sales growth by taking the ratio of the firm's total annual sales in a particular fiscal year to the sales aggregate fiscal years ago.

Export%. Export operations can have a significant impact on inventory levels. Jain et al. (2014) found that as sourcing moves

from domestic to global suppliers, inventory levels increase. We use the percentage of the firm's sales from exports as a proxy, which is a continuous variable.

#### 3.4.5 | Gross Margin

Rumyantsev and Netessine (2007) showed that inventory levels are higher for firms with higher gross margin, similar to the effect of the understocking cost in the newsboy model. It is not directly available in WBES and is calculated as one minus the ratio of total cost of sales to total sales.

#### 3.4.6 | GDP

GDP is the gross domestic product per capita. It is defined per country per year. It aims to cover the overall economic status of a country in a given year (Cheng et al. 2020). GDP is a commonly used proxy for country income level.

#### 3.4.7 | Industry

Different industries have different inventory needs. For example, between 1980 and 2000, the median days of inventory in the US for the tobacco industry is above 240, while it is below 40 in the printing and publishing industry (Chen et al. 2005). The industry data for each firm in the dataset are specified by the International Standard Industrial Classification (ISIC) codes. We use 2-digit ISIC codes of firms to calculate the dependent variable  $AbI_{it}$ . We also use a broader classification of industries in the study; manufacturing, retail, and other services for industry fixed effects in regressions and industry subgroup analyses.

### 3.5 | Sample

We used a multicountry combined dataset provided by the World Bank from 83 countries. As of June 26, 2017, the variable on a firm's inventory level is no longer included in the global questionnaire and has been removed from the website. Therefore, we used a dataset that covered the period between 2008 and 2016. We required data for all main variables defined in Table 1. The final sample that satisfied this requirement has  $N = 31,507$  firm-year observations. The data sample is not of panel structure, i.e., each firm is included only once in the sample. The business environment variables are used selectively throughout different analyses. Therefore, the presence of all business environment variables is not required for the final sample. Table 2 describes the data cleaning process followed.

The year and industry distribution of the sample is given in Table 3. Of the 83 countries considered, 10 are high-income, 26 upper middle, 35 lower middle, and 12 low-income countries. Thirteen of the countries are in East Asia and the Pacific region, 29 in Europe and Central Asia, 1 in Latin America and Caribbean, 10 in the Middle East and North Africa, 7 in South Asia, and 23 in Africa. India is the country with the highest number of observations and Djibouti the country with the lowest number. The country with the highest percentage of female-led companies (73%) is Thailand. The lowest

**TABLE 1** | Definitions of the variables used in the study. All variables are at firm-year level.

<b>Main variables</b>	
AbI	Abnormal inventory level of the firm wrt to mean firm in its industry.
Female TM	Dummy equal to 1 if the TM of the firm is female.
ln(Labor Prod)	The natural logarithm of annual total sales revenue divided by the number of permanent full-time employees.
<b>Business environment variables between 0 (no obstacle) and 4 (very severe)</b>	
Transport	The degree to which Transport is an obstacle to the firm's operations.
Land	The degree to which Access to Land is an obstacle to the firm's operations.
Finance	The degree to which Access to Finance is an obstacle to the firm's operations.
Labor	The degree to which Labor Regulations are an obstacle to the firm's operations.
Political	The degree to which Political Instability is an obstacle to the firm's operations.
Tax rate	The degree to which Tax Rates are an obstacle to the firm's operations.

(Continues)

**TABLE 1** | (Continued)

Total obstacle	The degree to which all above are an obstacle to the firm's operations.
<b>Control variables</b>	
TM experience	TM experience in sector (years).
Firm age	The difference between the year of survey and the year the firm started operations.
ln(Size)	The natural logarithm of the number of full time employees in the firm.
Sales growth	The ratio of the firm's most recent annual sales to sales 3 years ago.
Export%	The percentage of the firm's sale as direct export.
GrossMargin	One minus the ratio of total cost of sales to total sales.
ln(GDP)	The natural logarithm of gross domestic product per capita of the country in which the firm is located in.
Micro/Small/Medium	Dummy equal to 1 if the firm has < 10, between 10 and 49, or 50–249 employees.
Manuf/Retail/	Dummy equal to 1 if the firm operates in manuf., retailer or in other industries.
OtherInd	Transportation.

percentage of female-led firms is in Sudan (0 out of 46 firms). The female TM percentage per country in our sample is consistent with the sample used by Islam et al. (2018). The percentage of female TMs in the total sample decreases with the size of the firm, that is, 19.4% micro-sized firms have female TMs, while it is 13.7% of medium-sized firms. The percentage of female TMs is significantly higher in the retail industry (24.1%) compared to manufacturing (13.2%), which was also highlighted by Islam et al. (2018).

Table 4 reports the summary statistics of the sample used. The average firm size is 42.75 employees and the overall percentage of firms with a female TM is 18% in the main sample. Of the six business obstacles used, the tax rate was reported as the most significant obstacle, while labor regulations were the least significant.

**TABLE 2** | Data sample cleaning process.

	No. of observations
Firm-year observations in the WBES combined dataset between 2006 and 2017	101,853
“Not truthful” responses according to interviewer	20,884
Missing data on sales growth and value in top 1%.	19,191
Missing data on firm age	519
Missing data on export sales	256
Missing data on top manager's experience and values > 50	957
Missing data on firm size	227
Missing data on inventory and values > 365	3619
Missing data on top manager gender	17,207
Firms with number of employees > 250	3649
Missing data on gross margin	2450
Missing data for AbI calculation	1387
Final sample size ( <i>N</i> )	31,507

**TABLE 3** | Industry and Year distribution of the final sample.

2-digit ISIC	Definition	Fiscal year									Sample
		2008	2009	2010	2011	2012	2013	2014	2015	2016	Total (%)
15–37	Manufacturing	798	3990	189	757	1738	5848	6747	2497	492	73.2
45	Construction	29	75	5	29	27	52	51	113	25	1.3
50–52	Wholesale/Retail	389	1711	105	288	350	2150	1109	734	352	22.8
55	Hotels/Rest.	23	54	0	51	13	120	93	71	122	1.7
60–72	Other	8	110	0	14	0	28	52	73	25	1.0
	Total %	4.0	18.9	0.9	3.6	6.8	26.0	25.6	11.1	3.2	100

The correlations between the variables are given in Table 5. From these correlations, multicollinearity does not appear to be a problem, since all correlation coefficients are below 0.5. The highest correlations, while still below the commonly used cut-off values, are for the business environment variables. To ensure the nonexistence of multicollinearity, the variance inflation factor (VIF) scores for all independent variables are reported in Table 6. All scores are below the accepted threshold value of 10 (Kutner et al. 2005).

The differences in firm characteristics between female and male-led firms in our data sample illustrated by Figure 1, are consistent with those reported in previous studies that use WBES data investigating the effect of TM gender (Islam et al. 2018). Female-led firms are younger and smaller in size with higher growth rates and export percentages. There are more female-led firms in higher income countries (with higher GDP). Female-led firms are more evenly distributed among the three industries considered (manufacturing, retail, and other) compared to male-led firms, which are mostly employed in manufacturing. For business environment variables, female-led firms reported lower levels of observed business obstacles than male-led firms, as in Ali and Shabir (2017).

#### 4 | Model and Empirical Results

Our first three hypotheses aim to investigate whether the gender of the TM and obstacles observed in the business environment affect the inventory level of a firm and whether business obstacles moderate the relationship between the TM gender and the firm's inventory level. The dependent variable is the abnormal inventory level of the firm wrt mean inventory level in its industry in a year. Independent variables are the gender of the TM, the business environment variables, and their interactions with the gender of the TM, and the control variables on the characteristics of the firm.

We used linear mixed-effects models to account for the multilevel structure of the data, in which firms are nested within countries and observed over multiple years and industries, generating both cross-sectional and time-series variation. Year and industry are included as fixed effects. Year fixed effects absorb period-specific macroeconomic shocks that affect all firms simultaneously, while industry fixed effects control for systematic differences across industries. Country is modeled as a random intercept to capture unobserved cross-country heterogeneity arising from institutional,

**TABLE 4** | Descriptive statistics of the variables used in the study.

Variable	N	Mean	Median	Std. Dev.	Min.	Max.
AbI	31,507	0.00	-0.286	1.00	-1.89	12.00
FemaleTopM	31,507	0.18	0.00	0.36	0.0	1.00
ln(Labor Prod)	30,968	9.90	9.79	1.94	2.3	35.58
TopM experience	31,507	16.70	15.00	10.00	1.0	50.00
FirmAge	31,507	18.00	15.00	13.70	0.0	214.00
Size	31,507	42.75	21.00	49.81	2.0	249.00
ln(Size)	31,507	3.17	3.04	1.09	0.69	5.52
SalesGrowth	31,507	2.25	1.17	8.96	0.00	261.00
Export%	31,507	6.97	0.00	21.30	0.00	100.00
GrossMargin	31,507	0.81	0.86	0.17	0.00	1.00
ln(GDP)	31,507	3.48	3.48	0.42	2.44	4.78
<b>Business climate variables</b>						
Transport	31,261	1.13	1.00	1.18	0	4
Land	30,549	1.04	0.00	1.30	0	4
Finance	31,121	1.40	1.00	1.29	0	4
Labor	30,957	0.95	1.00	1.10	0	4
Political	30,569	1.49	1.00	1.46	0	4
Tax rate	31,242	1.69	2.00	1.31	0	4
Total obstacle	31,140	7.56	7.00	4.95	0	24

cultural, and economic differences given the large number of countries in the sample. Under this specification, the coefficients on firm-level variables capture within-country, within-industry variation over time, while the random country intercept absorbs baseline differences across countries. This modeling strategy accounts for the hierarchical nature of the data and improves the consistency of the estimated relationships.

ln(GDP) controls for country-year effects. In the final sample, for each country, data from at most 2 years are present. In addition, each firm is included in the sample exactly once. Hence, we do not include fixed effects at the firm-level. The main regression model is as follows:

$$AbI = \beta_0 + \beta_1 * FemaleTM + \beta_2 * Business\ Obstacles + \beta_3 * Control\ variables + \beta_4 * FemaleTM * Business\ Obstacles + \beta_5 * Year + \beta_6 * Industry$$

To investigate the relationship between the inventory level of a firm and the firm performance, the following regression model is used.

$$ln(LaborProd) = \beta_0 + \beta_1 * AbI + \beta_2 * AbI^2 + \beta_3 * Business\ Obstacles + \beta_4 * Control\ variables + \beta_5 * Year + \beta_6 * Industry$$

Regressions on both the direct and interaction effects of the TM gender and business obstacles are reported in Tables 7 and 8. In all regressions, when the female TM had a significant direct

effect, it was always negative. When all business environment variables were considered together, the presence of a female TM resulted in a significant decrease in inventory levels supporting **H1**. In Table 7, transportation and political instability have significant and positive direct effects on inventory levels. Besides, the total level of obstacles has a highly significant positive effect on inventories. The results confirmed our intuition on significant negative effects of business obstacles on firm growth and productivity, which would finally result in increasing firms' inventories (Rumyantsev and Netessine 2007) supporting **H2**.

Regarding the moderating effects of business obstacles, significant moderating effects were proved by transportation (marginally), finance (marginally), and political instability in Table 7. In female-managed firms, when political instability or finance was perceived as a more severe obstacle, inventory levels increased significantly compared to male-managed firms. However, when transportation became a more severe obstacle, female-led firms increased their inventories relatively less, enlarging the average inventory gaps between female- and male-led firms. Total level of obstacles perceived has a highly significant positive moderating effect on top manager gender and inventory relationship.

We investigate our hypotheses by industry and size subgroups with the results in Table 8. The female TM effect on inventories

**TABLE 5** | Pearson correlation matrix.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) AbI	1															
(2) F.TopM	0.002	1														
(3) ln(L.Prod)	0.052***	0.000	1													
(4) TopM Exp.	0.054**	-0.033**	0.068***	1												
(5) FirmAge	0.052**	-0.037**	0.070***	0.342**	1											
(6) ln(Size)	0.041**	-0.060**	0.122***	0.078**	0.169**	1										
(7) SalesGr.	-0.011	0.017**	0.063***	-0.017**	-0.016**	0.000	1									
(8) Export%	0.040**	0.016**	0.088***	0.057**	0.054**	0.240**	0.005	1								
(9) GrossM.	0.020**	-0.062**	0.379***	-0.003	0.018**	0.074**	0.067**	0.001	1							
(10) ln(GDP)	-0.011	0.074**	0.280***	0.146**	0.048**	0.067**	0.003	0.094**	-0.101**	1						
(11) Transport	0.015**	-0.027**	-0.026***	-0.049**	-0.008	0.008	0.024**	-0.011*	0.020**	-0.112**	1					
(12) Land	-0.001	-0.023**	-0.060***	-0.040**	-0.054**	-0.073**	0.029**	-0.050**	-0.001	-0.117**	0.327**	1				
(13) Finance	-0.001	-0.032**	-0.097***	-0.015**	-0.024**	-0.089**	0.027**	-0.043**	-0.045**	-0.086**	0.300**	0.399**	1			
(14) Tax Rates	0.009	-0.028**	0.014**	0.031**	0.023**	0.004	0.027**	-0.026**	0.022**	0.071**	0.284**	0.274**	0.320**	1		
(15) Political	0.022**	-0.038**	-0.068***	0.080**	0.040**	-0.049**	0.021**	-0.002	-0.017**	-0.054**	0.269**	0.241**	0.287**	0.343**	1	
(16) Labor	0.000	-0.038**	0.017**	-0.005	0.040**	0.069**	0.020**	0.018**	0.008	0.036**	0.338**	0.296**	0.300**	0.361**	0.263**	1

Note: \*\* and \* denote, respectively, correlation is significant at the 0.01 and 0.05 level (2-tailed).

**TABLE 6** | VIF score of the variables used in the study.

Variable	VIF score	Variable	VIF score
FemaleTM	1.80	Transport	1.20
TM experience	1.07	Land	1.21
Firm age	1.08	Finance	1.21
ln(Size)	1.07	Political	1.17
Sales growth	1.00	Tax Rate	1.20
Export%	1.04	Labor	1.21
ln(GDP)	1.22	GrossMargin	1.01

was significantly negative within manufacturing. While the significant positive direct effect of transportation still holds in manufacturing, obstacles in access to finance prove a significant negative effect in manufacturing. In retail, the positive moderating effect of political instability (marginally) is preserved in addition to the positive direct effect of labor (marginally). Interestingly, transportation shows a negative direct effect in other industries.

In analyses according to size subgroups, the direct effect of TM gender is pronounced in the micro-sized firm groups. Another important point is that in small-sized firms managed by women, political instability and access to finance proved significant positive and transportation negative effects on inventories similar to the whole sample. On the other hand, in medium-sized firms, tax rate-related obstacles lead to inventory increases when the TM is female.

Our findings indicate that all business obstacles considered in this study, except labor regulations and access to land, showed moderating effects on a firm's inventory level. Regression outputs and Figure 1 show that business environment obstacles significantly moderate the relationship between top manager gender and inventory levels, but that the direction of this moderation varies across obstacle types. Inventory levels increase with obstacle severity for both male- and female-led firms, indicating that obstacles heighten uncertainty and inventory investment overall. However, the evolution of the gender gap differs markedly across contexts.

Under transportation-related obstacles, the negative association between female leadership and inventory levels becomes stronger, with female-led firms maintaining relatively lean inventory positions even as obstacles intensify. This pattern is consistent with a pull-to-center response, in which logistics frictions heighten concerns over inventory immobility, overstocking, and capital lock-in for risk-averse managers. On the other hand, male-led firms adopt slack inventory policies to minimize financial risks, ensure agility when navigating disruptions, and prioritize responsiveness.

In contrast, under political instability, access-to-finance constraints, and tax-related obstacles, female-led firms increase inventory more sharply, narrowing or reversing the gender gap. Uncertainty in government policies may result in variations in information, cash, and physical flows throughout a company's supply chain, impacting operational decision-making. Similarly, facing obstacles regarding tax rates or

access to finance, female top executives may react more severely to ensure adequate inventory levels to support business operations. These obstacles appear to shift managerial attention toward continuity and precautionary buffering, activating push-from-center responses in which inventory serves as a hedge against systemic disruption.

Consistent with upper echelons theory and behavioral operations research, these findings suggest that business obstacles introduce joint supply- and demand-side uncertainty and activate competing behavioral biases. Which bias dominates depends on how top managers cognitively frame obstacle-induced risks. Female top managers' greater sensitivity to downside exposure leads them to respond selectively rather than mechanically to obstacle severity—reinforcing lean inventory strategies when overstocking risk is salient, but relaxing these strategies when continuity risk dominates. These patterns are also consistent with distinctions between risk and ambiguity in behavioral operations research: transportation obstacles may be perceived as recurring and structured risks, whereas political instability may introduce ambiguity with poorly defined outcomes, altering the precautionary value of inventory for risk-averse managers.

To test Hypothesis H4, firms from countries with missing CPI and/or exchange rate data are excluded from the sample. Among the control variables listed in Section 3.2, we omit firm size, sales growth, and gross margin, as they incorporate either total sales or number of full-time employees, which are components of our dependent variable, labor productivity.

The results, presented in Table 9, confirm a significant inverted U-shaped relationship between abnormal inventory level and firm performance supporting H4. An increase in inventory enhances performance up to a certain point, beyond which further increases negatively affect performance. The relatively low coefficient estimates are expected, given the logarithmic transformation of the dependent variable and the inclusion of strong country fixed effects.

While our findings support H4 and align with prior literature, the nonmonotonic relationship between inventory and performance raises further questions—particularly regarding how the typically lower inventory levels in female-led firms influence their performance. To explore this, we conduct a further test for concavity as outlined by Lind and Mehlum (2010), which evaluates whether the slope of a quadratic relationship is positive at the lower end and negative at the upper end of a chosen interval.

The first part of Table 10 reports the slope of the inventory at the stationary point and at  $\pm 1$  standard deviation, as well as at the minimum and maximum observed values. The stationary point is calculated as  $-\beta_1 / (2\beta_2) = 2.78$ , where  $\beta_1$  and  $\beta_2$  are the coefficients on  $AbI$  and  $AbI^2$ , respectively, from the regression in Table 9. Standard deviation values are drawn from Table 4. The slopes on either side of the stationary point are statistically significant, positive before, negative after, confirming an inverted U-shaped relationship. However, the mean and median abnormal inventory values in Table 4 are substantially below 2.78, indicating that most firms in the sample operate on the increasing side of the curve, where higher inventory is still associated with improved performance.

**TABLE 7** | Base regressions on top manager gender and inventory relationship.

<b>Dependent: AbI</b>	<b>All</b>	<b>Female top manager</b>	<b>Male top manager</b>	<b>Total obstacles</b>
FemaleTopM	-0.070** (0.030)			-0.063** (0.028)
TopM experience	0.003*** (0.001)	0.004** (0.002)	0.003*** (0.001)	0.003*** (0.001)
FirmAge	0.003*** (0.000)	0.003** (0.001)	0.003*** (0.001)	0.002*** (0.000)
ln(Size)	0.024*** (0.006)	0.034** (0.016)	0.022*** (0.006)	0.022*** (0.006)
SalesGrowth	-0.001 (0.001)	0.000 (0.001)	-0.001 (0.001)	0.000 (0.001)
Export%	0.001*** (0.000)	0.001 (0.001)	0.001*** (0.000)	0.001*** (0.000)
ln(GDP)	-0.148** (0.074)	-0.132 (0.079)	-0.147* (0.074)	-0.103 (0.065)
GrossMargin	0.023 (0.035)	-0.004 (0.082)	0.034 (0.039)	0.031 (0.033)
Transport	0.019** (0.006)	-0.010 (0.015)	0.019*** (0.006)	
Land	-0.003 (0.006)	0.007 (0.014)	-0.004 (0.006)	
Finance	-0.007 (0.006)	0.022 (0.014)	-0.008 (0.006)	
Labor	0.006 (0.007)	0.024 (0.017)	0.005 (0.007)	
Political	0.007 (0.006)	0.038*** (0.013)	0.008 (0.006)	
Tax rate	-0.002 (0.006)	0.015 (0.014)	-0.004 (0.006)	
Female TopM × Transport	-0.026* (0.015)			
Female TopM × Land	0.011 (0.014)			
Female TopM × Finance	0.024* (0.014)			
Female TopM × Labor	0.020 (0.016)			
Female TopM × Political	0.028** (0.013)			

(Continues)

TABLE 7 | (Continued)

Dependent: AbI	All	Female top manager	Male top manager	Total obstacles
Female TopM × Tax rate	0.005 (0.014)			
Total Obstacles				0.004*** (0.001)
Female TopM × Total obstacles				0.010*** (0.003)
Constant	0.260 (0.262)	0.118 (0.312)	0.264 (0.265)	0.082 (0.234)
Country effects	Random	Random	Random	Random
Year effects	Fixed	Fixed	Fixed	Fixed
Industry effects	Fixed	Fixed	Fixed	Fixed
<i>N</i>	28,785	4471	24,314	31,140
<i>R</i> <sup>2</sup>	10.0%	6.6%	9.9%	9.1%

Note: Standard errors are in parentheses. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

The second part of Table 10 shows simple slopes at the mean,  $\pm 1$  standard deviation, and  $\pm 2$  standard deviations of inventory. The slope remains significantly positive even at two standard deviations above the mean, reinforcing a monotonically increasing relationship within the range where most observations fall. To better understand this dynamic, we split the sample into two groups: firms with inventory above and below the stationary point, 2.78. Among the 784 firms with the abnormal inventory level above 2.78, female- and male-led firms have average abnormal inventory levels of 4.63 and 4.56, respectively. Among the 30,723 firms below or equal to the stationary inventory level, the averages of inventory are  $-0.141$  and  $-0.112$ , respectively for female and male-led firms. This shows that, on average, male-led firms operate closer to the performance-maximizing inventory level than female-led firms.

In conclusion, most firms in our sample maintain inventory levels below the stationary point that maximizes performance. Moreover, within both subgroups (above and below the optimal level), female-led firms tend to hold inventory levels further from the optimum than their male-led counterparts, contributing to a negative performance gap.

To assess the robustness of our findings to alternative performance measures, we reestimate the main specifications using gross margin as the dependent variable. The results are qualitatively similar to those obtained using labor productivity, indicating that our conclusions are not driven by the choice of performance proxy.

## 5 | Robustness Tests

### 5.1 | Regional Fixed Effects

To test the robustness of obtained findings, we repeated the basic regression analyses by incorporating the regional fixed effects. Most of the countries in the sample are large enough

that a country was stratified into regions. WBES use strata for geographical regions based on cities and regions according to their level of economic activity, population, level of development, literacy rate, etc., which might have an effect on the operational policies of firms in a particular region. For example, in our data sample, India had 23 regions and Turkey had 8. The regional dummies are at the region-country level and capture the regional characteristics of the region within which a firm was located. The results show that the negative effect of female top manager on inventory levels is still significant. Political instability has a marginally significant positive moderating effect on the female top manager and the relationship between the inventory level.

### 5.2 | Moderating Effect of Gross Margin

A stream of experimental work testing the decision biases in inventory ordering reported the existence of the pull-to-center effect (Schweitzer and Cachon 2000), which is the tendency of people to place orders between the critical fractile-based optimal quantity and the mean demand such that for the high (low) margin products, that is, critical fractile is above (below) 0.5, the actual order level is below (above) the optimal.

Though being very limited, behavioral studies that investigated the effect of gender in ordering relied on the pull-to-center phenomenon and tried to explain gender differences in ordering to their differences in risk aversion and emphasized the moderating effect of product profit margin in concern. While de Véricourt et al. (2013) observed significant gender differences only in high-profit settings, Villa and Castañeda (2020) showed that in low-margin settings male newsvendors place lower orders than female newsvendors, but gender-insensitive orders in high-margin settings. de Véricourt et al. (2013) explain their different findings in high- and low-profit settings with the differences in the benefit of risk-taking behavior in these two settings such that in high-margin

**TABLE 8** | Estimation of female top manager and inventory relationship by industry and firm size.

<b>Dependent: AbI</b>	<b>Manuf.</b>	<b>Retail</b>	<b>Other Ind.</b>	<b>Micro</b>	<b>Small</b>	<b>Medium</b>
FemaleTopM	-0.074** (0.038)	-0.041 (0.063)	0.010 (0.090)	-0.120** (0.057)	-0.056 (0.044)	-0.040 (0.061)
TopM experience	0.004*** (0.001)	0.004** (0.002)	0.000 (0.002)	0.004*** (0.001)	0.004*** (0.001)	0.002 (0.001)
Firm age	0.003*** (0.001)	0.001 (0.001)	0.005** (0.002)	0.001 (0.001)	0.002*** (0.001)	0.004*** (0.001)
ln(Size)	0.021*** (0.007)	0.035** (0.016)	0.039** (0.020)	0.066 (0.044)	0.032* (0.018)	0.007 (0.024)
SalesGrowth	-0.001 (0.001)	0.000 (0.002)	-0.001 (0.002)	0.000 (0.001)	-0.001 (0.001)	-0.002 (0.001)
Export%	0.001*** (0.000)	0.003** (0.002)	-0.001 (0.001)	0.001 (0.001)	0.001*** (0.000)	0.001*** (0.000)
ln(GDP)	-0.124 (0.082)	-0.185* (0.094)	-0.156 (0.122)	-0.098 (0.089)	-0.070 (0.070)	-0.208** (0.081)
GrossMargin	0.022 (0.042)	0.003 (0.086)	0.103 (0.096)	-0.055 (0.068)	0.017 (0.051)	0.111 (0.068)
Transport	0.026*** (0.007)	0.013 (0.015)	-0.034 (0.020)	0.013 (0.013)	0.025*** (0.009)	0.008 (0.012)
Land	-0.002 (0.007)	0.002 (0.014)	-0.011 (0.018)	0.014 (0.012)	0.001 (0.008)	-0.020* (0.011)
Finance	-0.014** (0.007)	0.020 (0.015)	0.006 (0.020)	0.005 (0.012)	-0.018** (0.008)	0.005 (0.011)
Labor	0.000 (0.008)	0.031* (0.018)	0.031 (0.023)	-0.004 (0.015)	0.006 (0.010)	0.007 (0.013)
Political	0.005 (0.006)	0.004 (0.014)	0.020 (0.018)	0.003 (0.012)	0.015* (0.008)	0.002 (0.011)
Tax rate	-0.003 (0.007)	-0.010 (0.015)	0.016 (0.020)	-0.021* (0.012)	0.001 (0.008)	0.006 (0.011)
Female TopM × Transport	-0.027 (0.019)	-0.037 (0.029)	0.044 (0.049)	0.000 (0.029)	-0.041* (0.021)	-0.033 (0.031)
Female TopM × Land	0.028 (0.018)	-0.018 (0.027)	-0.022 (0.043)	0.015 (0.026)	-0.003 (0.020)	0.016 (0.030)
Female TopM × Finance	0.006 (0.018)	0.044 (0.029)	0.020 (0.045)	0.038 (0.026)	0.041** (0.021)	-0.027 (0.030)
Female TopM × Labor	0.023 (0.020)	-0.036 (0.033)	0.034 (0.055)	0.026 (0.032)	0.036 (0.024)	-0.019 (0.033)
Female TopM × Political	0.025 (0.016)	0.043* (0.025)	0.022 (0.039)	0.013 (0.024)	0.039** (0.018)	0.016 (0.027)

(Continues)

TABLE 8 | (Continued)

Dependent: AbI	Manuf.	Retail	Other Ind.	Micro	Small	Medium
Female TopM × Tax rate	0.023 (0.018)	0.001 (0.027)	−0.070 (0.046)	−0.011 (0.026)	−0.012 (0.020)	0.079*** (0.029)
Constant	0.133 (0.295)	0.466 (0.345)	0.398 (0.466)	0.171 (0.334)	−0.013 (0.261)	0.344 (0.319)
Country effects	Random	Random	Random	Random	Random	Random
Year effects	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
Industry effects	No	No	No	Fixed	Fixed	Fixed
N	21,362	4698	2725	6661	13,990	8134
R <sup>2</sup>	11.3%	11.8%	16.2%	10.7%	7.8%	9.3%

Note: Standard errors are in parentheses. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

settings ordering more is rewarded in payoffs, while ordering more or less in low-profit settings is trickier due to the faint trade-off between increased overstocking costs and customer service level. Villa and Castañeda (2020) state that women make decisions that are oriented more toward a higher level of customer service, so order more than men, especially under low-profit conditions.

Motivated by this literature, we examine firm-level gross margin as a proxy for profit margin that may condition the relationship between gender and inventory management decisions. Given the mixed theoretical and empirical evidence regarding the direction of margin-contingent gender effects, and the difference between experimental product-level designs and our archival firm-level setting, we treat this analysis as exploratory and report it as part of the robustness tests.

We calculate the GrossMargin of a firm for each year by taking the ratio of total sales minus total cost to total sales. As the gross margin is a continuous variable, we form two subgroups of data by taking the firms in the bottom and top quartile according to GrossMargin values. The results reported in Table 11 show a highly significant and negative effect of female TM in firms with a low gross margin. On the other hand, in the high-margin firms subgroup, TM gender turns out to be insignificant.

The results are consistent with the theory that leads to H1. Women are found to be more loss averse than men, where loss and gain are defined according to a reference point (Uppari and Hasija 2018). While Herweg (2013) showed that under expectation-based reference selection, loss-averse decision makers order less than the risk neutral, Wang and Webster (2009) showed that this result is valid for underage cost being lower than overage, that is, low profit margin. Moreover, noting that men have been shown to be more overconfident than women (Barber and Odean 2001), Ren et al. (2017) showed that overconfident decision makers order more (less) for low (high) profit margin products than the traditional newsvendor. Our results confirm these intuitions for firms with female TMs that have significantly lower inventory levels when the gross margin is low. For high-margin firms, as the female TMs lean on a higher inventory policy with their loss and risk aversion as well as male TMs follow a lower inventory policy with higher overconfidence,

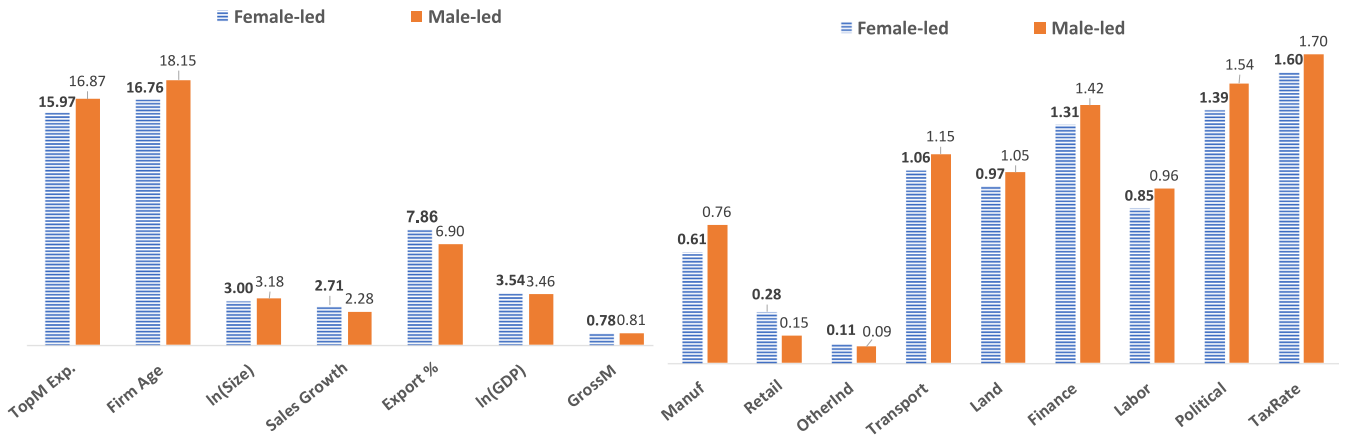
finally leads to insignificant differences in their firm inventory levels.

### 5.3 | Endogeneity Issues

Recent empirical research on top management gender consistently acknowledges the difficulty of identifying and fully eliminating endogeneity in the relationship between managerial gender and firm outcomes. In particular, it is challenging to disentangle whether female top managers influence firm performance and operational policies, or whether firms adjust their top management composition in response to changes in firm characteristics or performance (Compton et al. 2019). Firms managed by female top managers may therefore differ systematically from those managed by male top managers, as illustrated by Figure 2, and the appointment of a female top manager can be a deliberate strategic choice, potentially resulting in selection bias. For instance, transitions from male to female CEOs may occur during periods of organizational distress as part of a risk-mitigation strategy, a phenomenon commonly referred to as the “glass cliff” (Ryan et al. 2011).

In general, endogeneity concerns may arise due to measurement error, reverse causality, and omitted variables that jointly affect both managerial gender and firm outcomes. While endogeneity cannot be completely eliminated in observational studies without experimental or quasi-experimental data, prior research provides methodological guidance to mitigate these concerns to some extent (Däng et al. 2025).

There are two commonly recommended approaches in the literature used to address endogeneity concerns: instrumental variables and propensity score matching. Instrumental variables (IV) method requires instruments that are strongly correlated with top manager gender but plausibly uncorrelated with the error term in the outcome equation. However, due to the limited availability of gender-related variables and institutional instruments in the WBES dataset, as well as the cross-country nature of the sample, we are unable to identify credible and externally validated instruments for top manager gender. As a result, an IV-based approach is not feasible in our empirical setting.



**FIGURE 1** | Moderating effects of obstacles in transportation, access to finance, political instability, and tax rates on the relationship between TM gender and inventory levels (**H3**).

**TABLE 9** | Regression on Inventory and ln(Labor Prod) relationship.

Dependent: ln(Labor Prod)	
AbI	0.140*** (0.014)
AbI <sup>2</sup>	-0.025*** (0.003)
TopM experience	0.002** (0.001)
FirmAge	0.002*** (0.001)
Export%	0.005*** (0.000)
ln(GDP)	1.273*** (0.245)
Constant	5.633*** (0.866)
Country effects	Random
Year effects	Fixed
Industry effects	Fixed
N	30,968
R <sup>2</sup>	57.4%

Note: Standard errors are in parentheses. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

Given the binary nature of our key independent variable (top manager gender), we adopt propensity score matching (PSM) as a sensitivity analysis to mitigate selection on observables. We construct a control group of firms with male TMs that is similar to the treatment group of firms with female TMs. For matching, we perform a propensity score matching algorithm in which matching control firms are selected from the same country, industry, and year and then matched using the firm and TM characteristics TM Experience, Firm Age, ln (Size), Sales Growth, Export% and GrossMargin. We used the Matchit package in R with single

**TABLE 10** | Inverted U-shaped hypothesis testing for effect of Inventory on ln(Labor Prod).

	Value	Slope	t	p
Minimum value	-1.89	0.235	10.19	0.000
Stationary point -1 SD	1.79	0.050	5.99	0.000
Stationary point +1 SD	2.78	0.000	—	—
Maximum value	3.78	-0.050	-3.72	0.000
Mean -2 SD	12.00	-0.464	-8.03	0.000
Mean -1 SD	-1.993	0.240	10.17	0.000
Mean	-0.997	0.190	10.30	0.000
Mean +1 SD	0.000	0.000	—	0.000
Mean +2 SD	0.997	0.090	9.16	0.000
	1.993	0.040	4.77	0.000

nearest-neighbor matching (Randolph et al. 2014). We set a caliper value of 0.25 standard deviations for a good-match (Shen et al. 2023). After matching, we have 4102 firm-year observations for female-led firms and a matching sample of male-led firms. The *t*-tests for the matched firms are reported in Table 12.

Regressions for the matched sample, which is a replication of the regression carried out on the original unmatched sample, show that the main result on lower inventory levels held by female-led firms than male-led ones still holds after ensuring a balanced sample of female- and male-led firms with very similar characteristics. Regarding business obstacles, the significant positive moderating effect of political instability and total obstacles (marginally) and the direct effect of tax (marginally) still hold.

#### 5.4 | Ownership Gender Effect

Recently, gender studies in management raised the concern to differentiate between ownership and decision-making authority

**TABLE 11** | GrossMargin subgroup analysis for female top manager and inventory relationship.

Dependent: AbI	Bottom quartile	Top quartile
FemaleTopM	-0.160*** (0.055)	-0.040 (0.060)
TopM Experience	0.003** (0.001)	0.003** (0.001)
FirmAge	0.004*** (0.001)	0.002*** (0.001)
ln(Size)	0.015 (0.012)	0.043*** (0.011)
SalesGrowth	-0.002 (0.002)	-0.001 (0.001)
Export%	0.001* (0.001)	0.002*** (0.001)
ln(GDP)	-0.125 (0.087)	-0.194** (0.080)
Transport	0.017 (0.013)	0.023** (0.011)
Land	0.030** (0.012)	-0.014 (0.011)
Finance	-0.007 (0.012)	-0.006 (0.011)
Labor	-0.017 (0.014)	0.000 (0.013)
Political	0.008 (0.011)	0.006 (0.010)
Tax Rate	0.016 (0.012)	0.001 (0.011)
Female TopM × Transport	-0.032 (0.028)	-0.040 (0.029)
Female TopM × Land	0.009 (0.026)	-0.003 (0.027)
Female TopM × Finance	0.004 (0.027)	0.007 (0.029)
Female TopM × Labor	0.051 (0.031)	0.071** (0.033)
Female TopM × Political	0.057** (0.024)	0.014 (0.025)
Female TopM × Tax Rate	0.040 (0.026)	-0.006 (0.028)

(Continues)

**TABLE 11** | (Continued)

Dependent: AbI	Bottom quartile	Top quartile
Constant	0.221 (0.313)	0.343 (0.287)
Country effects	Random	Random
Year effects	Fixed	Fixed
Industry effects	Fixed	Fixed
N	6937	7316
R <sup>2</sup>	11.1%	9.8%

Note: Standard errors are in parentheses. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

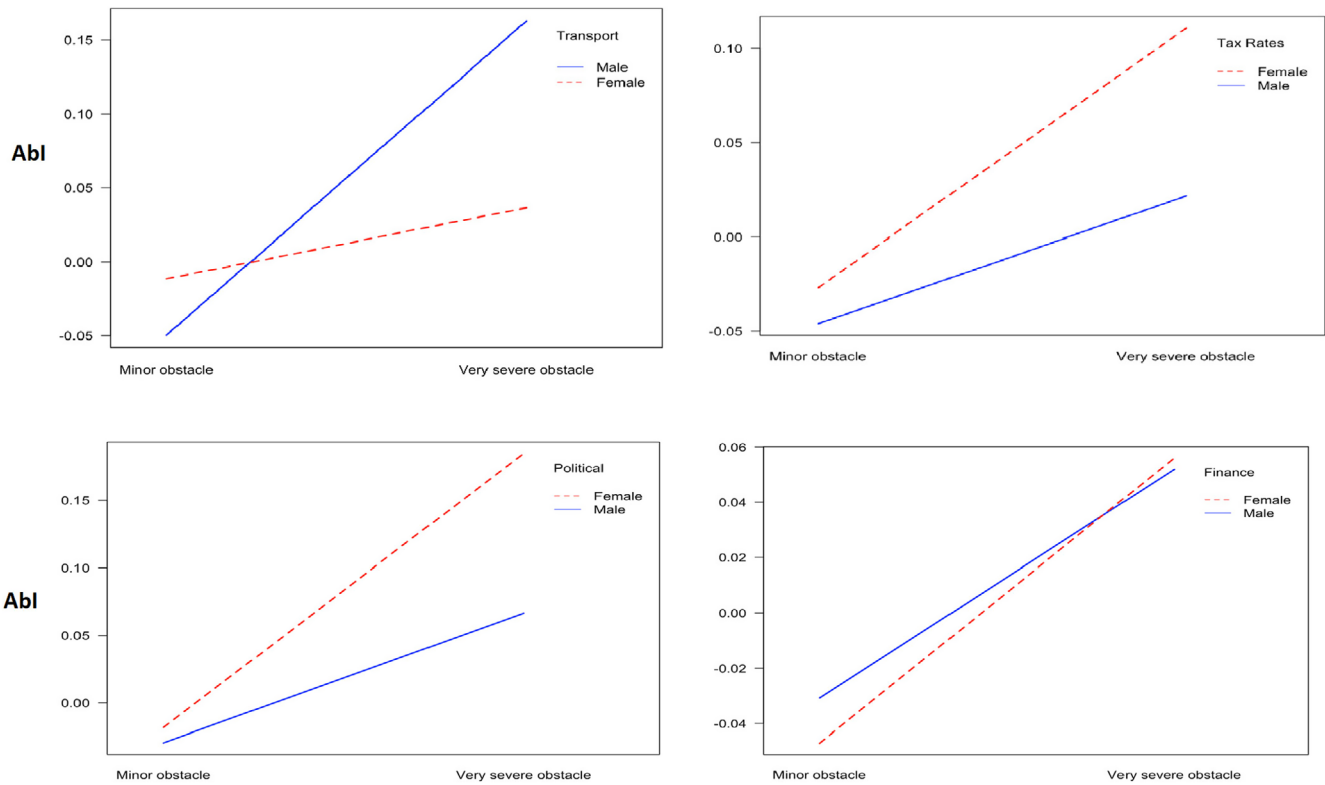
to better evaluate the gender effect in a firm's decisions and performance. Islam et al. (2018) investigated the gender gap in a firm's labor productivity. They found that the gender of the decision maker, either as a TM or as an owner, was related to the productivity of a firm in favor of male decision makers, but the gender of the owner, who may not be involved in decision making, did not show any significant effect on productivity.

Although inventory management is mostly a tactical decision, lean operations is a strategic policy that will also determine operating inventory levels. Thus, a firm's inventory level can be set as a result of TMs' management policy, as well as the firm's owners' strategic policy. Thus, we repeated our analyses of the effect of gender on inventory levels considering the gender distribution of ownership as well. We used the variable FemaleOwn as the percentage of the firm owned by women. If the firm had a sole owner and he/she was also the TM, the variable on the TM gender and the percent of firm owned by women would correspond. Otherwise, if there were multiple owners and/or the TM was not one of the owners, FemaleTM and FemaleOwn would take different values.

Requiring data for FemaleOwn and all the main variables defined in Table 1, except FemaleTM, the final sample had  $N = 5903$  firm-year observations. This sample is smaller because, while many firms report whether any owner is female, fewer report the exact ownership share. We focus on ownership percentage rather than a binary indicator, as the percentage owned by women better may capture their potential influence on firm operations.

For all subgroups considered, female ownership is shown to have a negative effect on inventories, but only significant for small-sized firms. Among the business environment variables assessed, only access to land had a significant positive direct effect on inventories and also a significant negative moderating effect on the association between female ownership and inventory levels.

While we generally observe a negative association between female ownership and inventory levels, the relationship is weaker and less robust across specifications. In contrast, the effect associated with female top managers remains consistently stronger. This pattern suggests that inventory policies in SMEs are more closely related to managerial characteristics than to ownership structure. The result supports our focus on the active role of top



**FIGURE 2** | Mean differences of variables between female and male-led firms.

**TABLE 12** | Post matching test of mean differences by top manager gender.

Variable	Female top manager	Male top manager	p
AbI	-0.01	-0.01	0.833
TopM Experience	15.59	16.10	0.017**
FirmAge	16.69	16.45	0.364
ln(Size)	3.06	3.08	0.326
SalesGrowth	2.37	2.62	0.25
Export%	7.65	7.11	0.280
ln(GDP)	3.5	3.5	1.000
GrossMargin	0.80	0.79	0.641
Manuf	0.65	0.65	1.000
Retail	0.25	0.25	1.000
OtherInd	0.10	0.10	1.000

managers in both strategic and operational decisions, especially in private SMEs, which has been often highlighted by past work (Perrin and Weill 2023).

## 6 | Theoretical and Managerial Implications

The main objective of gender studies in management is to examine whether behavioral differences, including potential

biases, influence managerial decision-making processes based on the gender of the decision maker. Beyond gender, other demographic attributes, such as education, age, and professional experience, have also been investigated as predictors of managerial behavior. Identifying associations between such characteristics and managerial decisions helps inform the development of organizational policies, incentive structures, and decision support tools that help mitigate bias and promote more effective and inclusive decision-making. In this study, we specifically explore how inventory management policies vary according to the gender of an SME's top manager and owners, and how these gendered patterns interact with perceived obstacles in the business environment. Importantly, the study also examines whether these inventory policies lead to differences in firm performance. The findings underscore the importance of designing decision support systems in operations, particularly inventory management, that account for behavioral tendencies and help reduce the influence of individual-level biases, especially under conditions of uncertainty and environmental disruption. Below we highlight in detail the theoretical and managerial implications of our work.

### 6.1 | Theoretical Implications

This study offers several important theoretical contributions to the fields of operations management, gender and leadership research, and the UET. First, it extends the UET (Hambrick and Mason 1984) by empirically demonstrating that top manager gender in SME's is not only associated with high-level strategic decisions but also with specific operational policies, in this case, inventory management. Although prior research has emphasized how managerial demographics affect broad firm outcomes

such as innovation, profitability, and strategic orientation (Wu et al. 2021), our findings show that gendered managerial behavior also manifests itself in critical decisions related to resource allocation and risk management at the operational level. This reinforces the calls by Roels and Staats (2021) and Zinn et al. (2018) for greater integration of behavioral and demographic variables into operations management research.

The study contributes to behavioral operations by bridging insights from experimental research with large-scale, real-world firm-level data for SMEs. Previous experimental studies have identified gender-based differences in inventory decisions under controlled conditions (e.g., de Véricourt et al. 2013; Becker-Peth et al. 2018), attributed to differences in risk aversion, loss aversion, and overconfidence. Our empirical analysis confirms that such behavioral patterns persist at the firm level, with female TMs keeping significantly lower inventory levels than male TMs, particularly under specific environmental constraints. This provides external validity to the behavioral literature.

Our findings underscore the importance of incorporating environmental context into upper echelons and behavioral operations research. Specifically, we show that the relationship between TM gender and inventory policy is moderated by perceived business environment obstacles such as transportation infrastructure and political instability. This aligns with and advances contingency perspectives within the UET, which posit that the effects of managerial characteristics are shaped by external conditions. The nuanced moderating effects, such as female TMs increasing inventory under political instability but reducing it under transportation obstacles, suggest that managerial responses to risk are context-specific and mediated by the nature of the uncertainty faced.

Within this context, this study also demonstrates that SMEs strategically adjust inventory levels in response to perceived business obstacles. The debate surrounding lean strategies highlights a central trade-off: while lean practices can enhance efficiency and improve financial performance through reduced inventory and increased asset returns (Modi and Mishra 2011), they may also expose firms to greater vulnerability during disruptions due to reduced slack and buffer capacity (Kleindorfer and Saad 2005). A considerable body of the literature has discussed inventory as a key redundancy strategy to mitigate supply, demand, and control risks, and to enhance operational resilience. However, scholars have also emphasized the need for more empirical evidence on how firms adjust inventory in response to perceived environmental constraints (El Baz and Ruel 2021). This study suggests that inventory slack is actively used as a resilience mechanism and to mitigate the disruptive effects of perceived business obstacles.

Finally, examining the effect of gendered ownership structure alongside TM gender adds theoretical depth. Our findings indicate that both female TM presence and higher female ownership are associated with more conservative inventory policies, supporting the argument that gender-based behavioral traits influence firm decisions through multiple channels. This contributes to ongoing discussions in the literature on the need to differentiate between ownership and managerial control in studies of gender and firm behavior (Islam et al. 2018).

## 6.2 | Managerial Implications

The findings of this study offer several important managerial implications for practitioners, particularly those involved in operations, supply chain management, and strategic leadership development. First, the evidence that female TMs in SMEs are associated with significantly lower inventory levels compared to their male counterparts suggests that gender-based behavioral traits, such as greater risk aversion and caution in resource allocation, can influence inventory policy. This highlights the need for firms to recognize that managerial diversity not only shapes strategic vision but also affects core operational practices. In environments characterized by uncertainty and resource constraints, this may lead to varying risk management and responsiveness strategies.

Second, the results demonstrate that the relationship between TM gender and inventory policy is moderated by the business environment. Specifically, firms managed by female TMs tend to reduce inventory under transportation-related constraints but increase it in contexts of political instability, having difficulty accessing finance or tax rates, indicating a more nuanced and context-sensitive approach to managing operational risk. This suggests that female leaders may adopt more adaptive inventory strategies depending on the perceived nature of external threats.

Third, the differentiated effects of business obstacles across firm size and industry imply that inventory strategies should be calibrated not only to the external environment but also to firm-specific characteristics. For instance, female TMs in small firms are more sensitive to financial constraints, while those in medium-sized firms respond more significantly to tax-related obstacles. These findings suggest that a one-size-fits-all approach to operational decision-making may be inadequate. Instead, SMEs should integrate gender-informed and context-specific considerations into their decision support systems and supply chain planning tools.

Furthermore, the results regarding female ownership indicate that gender-related behavioral influences extend beyond top management to strategic governance roles. Firms with higher female ownership also pursue more conservative inventory strategies, though being weaker, reinforcing the view that gender diversity at all levels of leadership can shape firm behavior. For policymakers and business development organizations, these findings underscore the value of supporting women's participation in both managerial and ownership roles, not only from an equity perspective, but also as a factor influencing organizational resilience and efficiency.

Finally, understanding how gender and environmental conditions jointly shape inventory decisions can support the development of more effective and inclusive operational policies. Firms should consider investing in decision support systems and managerial training programs that reduce unconscious biases and promote best practices in inventory management, especially during uncertain business environments. In doing so, they can enhance both the robustness and adaptability of their supply chains while leveraging the benefits of diverse leadership.

## 7 | Concluding Remarks

In this study, we compared female and male TMs in terms of their inventory management policies, which are generally claimed to have different risk propensity and overconfidence in various anecdotal evidence and previous work. Analyses proved significantly lower industry-adjusted inventory levels at female-led firms than at male-led ones. Female-led firms also reported significantly lower levels of observed business obstacles. Our results indicated that female TMs may keep higher or lower inventory levels when faced with obstacles in the business environment. In particular, when transportation represents a higher obstacle to a firm's operations, female TMs tend to keep less inventory than their male counterparts. On the other hand, under a higher perceived political instability or obstacle in access to finance, female TMs keep significantly higher inventory levels. We also found that small-sized firms with female TMs are more sensitive to obstacles related to access to finance, while in medium-sized firms, they are more sensitive to tax rates.

Furthermore, we studied the effect of the percentage of female ownership on inventory levels. We found consistent but quantitatively weaker effects of the gender distribution of the owner on the firm's inventory levels. The findings confirm previous studies that differentiated between the decision-making roles of TMs and owners, now in an inventory management context (Islam et al. 2018).

To understand the managerial implications of our findings, we investigated how inventory levels might influence firm performance within our dataset, a topic that has been examined in several previous studies in operations management. Our primary analysis supports the existence of an inverted U-shaped relationship between inventory levels and firm performance. However, we also show that most firms in our sample operate in the increasing portion of this curve. Notably, female-led firms tend to maintain inventory levels that deviate more significantly from the estimated performance-maximizing threshold compared to their male-led counterparts. This discrepancy highlights the importance of structural differences in inventory policies, which may be influenced by corporate governance choices.

There may be concerns about the Enterprise Surveys dataset collected and provided by the World Bank. One concern is the endogeneity in the dataset (Stank et al. 2024). Although some variables in the dataset were objective information, such as firm age, number of employees, gender of the TM, etc., some others were subjective perceptions of the respondents, such as business environment variables. Thus, respondents may have been biased in reporting subjective variables by the values of objective variables. To address this endogeneity issue, Véganzonès-Varoudakis and Nguyen (2018) predicted subjective variables by building a linear combination of some exogenous variables. Commander and Svejnar (2011) used an average value of each obstacle reported by all other firms in a given industry in each country and year, or all other firms of a given size in a given industry in each country and year. They reported that estimates remained the same mainly compared to the analyses using firm-own-reported obstacle values.

Another concern is the selection and use of appropriate business environment variables among the 16 variables collected by

WBES. In this study, we followed an intuitive selection and used those that intuitively related to inventory management of a firm, while making sure that one variable was selected from each of the four categories defined by Nam et al. (2016), which used the analysis of the principal components to propose these categories.

There may be a possible lagged relationship between perceived business obstacles and inventory levels. World Bank conducts Enterprise Surveys once in several (2 to 5) years in a country (Enterprisesurvey 2023). Thus, in the final sample we used that covered the period 2008–2016, for each country, data from at most two years are present. In addition, in this data sample, each firm is included exactly once. Hence, the data are not panel that will allow lagged relationship analysis. World Bank also has panel data for some countries and years, but is very limited compared to the data sample we used.

One of the most challenging aspects of our findings is the presence of significant but opposite moderating effects of business obstacles on the relationship between top manager gender and inventory policy. For example, transportation-related obstacles widen the inventory gap between female- and male-led firms, whereas political instability narrows or reverses this gap. While gender differences in risk propensity are well documented, how such differences manifest across varying risk contexts remains more debated. Our results suggest that understanding the nature of business obstacles and how they are perceived by managers is critical for explaining heterogeneous inventory responses. An important avenue for future research is therefore to further disentangle business environment variables and identify the types of risks they activate in managerial decision-making.

These findings also connect to a growing literature that refines the concept of uncertainty in inventory management. Prior research distinguishes between risk, where outcome probabilities are known or estimable, and ambiguity, where probabilities or outcomes are poorly defined (Ma and Aloysius, 2024). Behavioral studies show that ambiguity can lead decision makers to reduce inventory despite heightened uncertainty, a pattern that contrasts with traditional buffering logic (Ancarani et al. 2013). In our context, business environment obstacles may differ in whether they are perceived as structured risks or as ambiguous uncertainty. While transportation constraints may be interpreted as recurring and relatively predictable disruptions, political instability may introduce ambiguity with uncertain scope, duration, and consequences, altering the perceived costs and benefits of inventory holding.

A related stream of research emphasizes the source of uncertainty, distinguishing between demand- and supply-side disruptions. Evidence suggests that decision makers respond differently depending on whether uncertainty is attributed to demand variability, supply unreliability, or internal versus external factors (Hofstra et al. 2022). Importantly, real-world business obstacles often affect both demand and supply conditions simultaneously, making it difficult to classify them along a single dimension. Our findings reinforce the need to move beyond one-dimensional treatments of uncertainty in operations research and highlight the value of incorporating managerial cognition and executive characteristics—such as gender—into the study of inventory and working capital decisions.

Future research could complement our findings using qualitative methods, such as interviews or field studies with managers responsible for inventory decisions, to examine how supply disruptions, financial constraints, and institutional instability are perceived and prioritized in practice. Such work would help clarify the behavioral mechanisms underlying gender differences in operational decision-making and provide deeper insight into how managers frame inventory as either a financial exposure or a resilience buffer.

Recent developments in female empowerment, such as sustainability initiatives, technological innovations, and major supply chain disruptions, for example, the Covid-19 pandemic, can give rise to testing the existence and if there is any direction of these differences between female and men-led firms. Future work can address these recent developments using an appropriate dataset.

Another promising direction for future research is to examine the role of the gender composition of the top management team (TMT) and/or the board of directors, alongside the gender of the top manager. Drawing on social identity theory, scholars suggest that female leaders can act as influential role models for other female executives and board members, potentially improving the quality of decision-making and overall firm performance (Meliá-Martí et al. 2024). Incorporating the gender composition of the TMT could offer deeper insight into the mechanisms shaping gender-related dynamics in operational decision-making, contingent on the availability of appropriate data, which is currently not provided by the World Bank Enterprise Surveys we use for this study.

### Conflicts of Interest

The authors declare no conflicts of interest.

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