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Resilience of GVC suppliers in politically unstable regions: The roles of governance and trust

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ABSTRACT

Supplier firms in the Global South face compounded risks from political instability that challenge their ability to maintain participation in global value chains (GVCs). While resilience is increasingly acknowledged as a critical capability, it remains unclear how suppliers develop resilience when conventional GVC governance strategies, often grounded in institutional stability, prove insufficient. This gap is especially pronounced in knowledge-intensive service sectors like software development, where codification, coordination, and inter-firm trust are central but often disrupted by political instability. This study examines the resilience of GVC suppliers operating in politically unstable regions of South Asia, particularly India and Pakistan. It focuses on the role of governance mechanisms—such as codification, managing complexity, and supplier capabilities, on supplier resilience. It also investigates how trust moderates these relationships. Drawing on Transaction Cost Economics (TCE) and the Dynamic Capabilities View (DCV), we argue that these governance mechanisms function not only as efficiency enablers but also as dynamic governance adaptations that suppliers actively mobilize to survive and adapt. A quantitative analysis using partial least squares structural equation modeling (PLS-SEM) was conducted on survey data collected from 100 software firms. The results show that task codification and management of task complexity enhance supplier resilience. It further reveals that trust negatively affects the links between task codification and resilience, challenging the conventional assumption that trust uniformly strengthens GVC relationships. The core theoretical contribution of this study lies in extending TCE and DCV by showing how resilience is enabled through external governance adaptation and by rethinking trust as a conditional, context-dependent mechanism rather than a universal good.

1. Introduction

In recent decades, GVCs have enhanced trade and investment connectivity, offering upgrading opportunities for firms in developing economies (Choksy et al., 2022; Contractor et al., 2010; Zahoor et al., 2023). The coordination of lead firms has increased interdependence among companies, suppliers, and consumers (Ali et al., 2022; UNCTAD, 2013). This interconnectedness promotes efficiency but also heightens

vulnerability to external shocks. Notably, political instability in vulnerable regions has emerged as a significant disruptor due to rising geopolitical risks and protectionist policies (Gereffi, 2018; World Bank, 2020). Political instability manifests in regime changes, civil unrest, trade disputes, policy shifts, violence, strikes, and regulatory uncertainty. It also harms the reputation of firms in unstable regions, deterring partnerships and reducing foreign investment (Dutt & Mitra, 2007; Sinkovics et al., 2019; Akamavi et al., 2023; Rasul & Manandhar, 2009).

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For instance, Pakistan's instability post-2013 elections undermined investor confidence (Dogar and Khalid, 2024; Siddiqui, 2019). Similarly, Sri Lanka's 2021 ban on chemicals drastically lowered rice and tea production, while major textile brands shifted orders to India due to the economic crisis (The Island, 2022). The interconnected nature of GVCs means that instability in one region can strain relationships across the entire chain (Tukamuhabwa et al., 2017).

Despite the cascading impact of regional instability on GVCs, scholarly understanding remains limited regarding the mechanisms through which supplier firms embedded in politically volatile contexts cultivate resilience to navigate such uncertainties. As GVCs increasingly include suppliers from politically unstable regions, this raises a critical question about how these suppliers survive and adapt when institutions, particularly those related to political instability and violence, are weak and conventional GVC governance practices may no longer be effective. This is particularly important in knowledge-intensive service sectors, such as software development, where ongoing interaction and knowledge connectivity are fundamental, but often disrupted in adverse contexts (Sinkovics et al., 2019). Against this backdrop, this study explores two inter-related research questions within the context of South Asia's political instability operating in GVCs: 1) *How do individual GVC governance mechanisms influence suppliers' resilience in politically unstable regions?* 2) *How does trust moderate the relationship between GVC governance mechanisms and supplier resilience?*

Recently, there have been studies focusing on how firms can adapt to environmental disruptions in GVCs, including a large-scale pandemic crisis (Choksy et al., 2022; Islam & Chaddee, 2024) and political instability and violence (Sinkovics et al., 2019). As a result, there is growing interest in investigating resilience in GVCs (Gereffi, 2022; Kano et al., 2022). Recent literature acknowledges that supplier resilience is vital to GVCs because the supplier's ability to respond to and adapt to environmental disruptions, specifically political instability in the home country (as indicated in examples above), has a ripple effect on other parts of GVCs (Choksy et al., 2022; Pla-Barber et al., 2021; Tukamuhabwa et al., 2017).

Given the critical role of supplier resilience in addressing political instability, it is important to understand the influence of GVC governance on shaping resilience. Research highlights the link between GVC governance structures (ranging from captive to relational and modular) and the capacity of GVC firms to mitigate risks from external shocks (Choksy et al., 2022; Kano et al., 2022; Sinkovics et al., 2019). These GVC governance structures are supported by three mechanisms: codification, complexity, and supplier capability. Codification clarifies processes; complexity necessitates management of adaptive coordination, while supplier capability includes the necessary resources and skills to meet GVC demands (Gereffi et al., 2005). Some studies have challenged the assumption that resilience in GVCs is shaped by static governance structures like relational or modular GVC (Islam and Chaddee, 2024; Kano et al., 2022). Although GVC governance structures provide useful typologies, they do not fully explain how firms adjust to environmental disruptions. We integrate the dynamic capabilities view (DCV) with the Transaction Cost Economics (TCE) perspective, arguing that it is essential to focus on the individual roles of task codification, managing task complexity, and supplier capability in enhancing supplier resilience, as these governance mechanisms better capture the dynamics of GVCs and political instability (Kano et al., 2022). These mechanisms can assist firms in maintaining continuity and adaptability amid political instability (Pla-Barber et al., 2021), highlighting a gap in existing research.

In addition to GVC governance mechanisms, trust also plays a vital role in supplier resilience within GVCs (Pasquali & Alford, 2022). Trust is the readiness of one party to rely on another, expecting they will deliver essential actions (Mayer et al., 1995). Trust influences the relationships between lead firms and suppliers in GVC governance (Can Saglam et al., 2022; Faruquee et al., 2021; Pasquali and Alford, 2022), helping to reduce opportunism, conflict, and transaction costs

(Anderson et al., 2017; Zaheer et al., 1998).

However, trust may have an overlooked "dark side" in the context of suppliers' resilience within the GVCs (Sinkovics et al., 2021). The same trust that is often lauded can introduce complexities into these relationships. To this end, Pasquali and Alford (2022) emphasize the significance of governance systems in adapting to a low-trust environment and support the notion that reliance on trust alone may not be sufficient to ensure resilience, especially in politically unstable contexts. Similarly, most research on the dark side of trust focuses on the buyer's perspective, with the exception of Sinkovics et al. (2021). Accordingly, the interplay between governance mechanisms, trust, and resilience is particularly critical for suppliers in politically unstable regions. Task codification reduces ambiguity, ensuring that all parties align their expectations and actions. In high-trust relationships, firms that rely solely on trust without codified processes may struggle to recover when disruptions expose misalignments or unmet expectations (Verbeke et al., 2021). Managing task complexity demands frequent coordination, adaptability, and robust communication, particularly under adverse conditions. Excessive trust may reduce the urgency to establish rigorous coordination mechanisms, leaving suppliers ill-prepared to handle rapidly evolving disruptions in politically unstable regions. Firms with high capabilities are better equipped to adapt to changes during crises. However, excessive trust may diminish the focus on developing these capabilities that are essential for resilience (Sinkovics et al., 2021; Villena et al., 2020). As such, there is limited knowledge about how individual governance mechanisms, task codification, managing task complexity, and supplier capability, function as adaptive mechanisms for supplier resilience in politically unstable regions. Moreover, the role of trust remains undertheorized, often assumed to be beneficial without considering its potential dark side in politically unstable regions.

Drawing upon TCE and DCV perspectives, our study examines the role of individual GVC governance mechanisms and trust in shaping supplier resilience in politically unstable GVCs. In so doing, we focus on how software development suppliers (See Choksy, 2015; Choksy et al., 2024; Sinkovics et al., 2019) navigate challenges instigated by political instability in South Asia when doing business with international clients (Butollo et al., 2022; Dilyard et al., 2021; Strange and Zucchella, 2017). Using a survey design methodology, our questionnaire employs multi-item measures to capture governance mechanisms, resilience, and trust. We analyze questionnaire data drawn from 100 South Asian software firms using Partial Least Squares Structural Equation Modelling (PLS-SEM) to test the hypothesized relationships in the interplay between governance mechanisms, trust, and resilience. The findings indicate the positive impact of task codification and managing task complexity on suppliers' resilience while highlighting the negative moderating role of trust in the task codification-resilience relationship.

The software industry is a knowledge-intensive sector that demands continuous coordination among geographically dispersed teams (Choksy et al., 2024; Choksy, 2015). Unlike manufacturing, where processes are standardized, software development relies heavily on task codification to manage both structured knowledge and evolving project requirements. At the same time, suppliers need to manage complexity to handle more specialized (and tacit) knowledge related to software design and user experience, which is difficult to codify. These factors require ongoing coordination with the international client. Political instability heightens risks for offshore software providers by increasing client uncertainty, disrupting workforce availability, amplifying cybersecurity concerns, hindering foreign travel plans, creating a negative country perception for Western clients, and eroding the local industry's global reputation as a result of political instability (Sinkovics et al., 2019). For instance, Sinkovics et al. (2019) explain that during periods of heightened terrorism-related security concerns in Pakistan, software firms experienced reduced international outsourcing contracts, leading to increased client risk perceptions. These challenges are particularly evident in South Asia, where software firms operate within volatile institutional environments yet remain key players in global outsourcing

markets (Arshad et al., 2024). This makes governance mechanisms critical for resilience, yet existing GVC research has largely overlooked service-based industries like software development (Choksy et al., 2024).

Our study contributes to the IB literature on GVC governance and resilience by challenging static structural conceptions of governance and offering a dynamic, context-sensitive understanding of how supplier resilience is enabled in politically unstable environments. Building on and extending the foundational GVC governance typology (Gereffi et al., 2005) and recent calls for governance adaptation (Islam and Chadee, 2024; Kano et al., 2022), we demonstrate that task codification and managing task complexity function as dynamic governance adaptations rather than fixed structural mechanisms. This extends the existing literature by showing that task codification and managing task complexity are governance attributes and dynamic tools that balance governance efficiency (as emphasized in TCE) with adaptability (as highlighted in DCV), shaping supplier resilience under politically unstable environments.

We also problematize the assumption that supplier capability alone is sufficient for resilience by demonstrating that, under political instability, external governance mechanisms play a more critical enabling role than internal capabilities by themselves. Finally, our study illuminates the role of trust as a moderator in the nexus of GVC governance mechanisms and supplier resilience. We contribute to the emerging critical literature on trust by revealing that excessive trust may undermine resilience, thereby challenging the conventional view of relational GVC governance as universally beneficial. Through this integrated lens, our study enhances theoretical understanding of how resilience is not merely a firm-level attribute, but an outcome of inter-organizational governance reconfiguration and suppliers' capacity to adapt to these governance mechanisms. In this way, we extend both the TCE and DCV literature by demonstrating how efficiency and adaptability must be balanced through dynamic governance strategies in adverse contexts. Practically, it provides actionable insights to practitioners for balancing trust with adaptive governance strategies in politically unstable regions to manage task complexities and strengthen capabilities.

2. Theoretical background

This study develops a theoretical framework that integrates the DCV and TCE to understand the GVC governance mechanisms influencing supplier resilience within GVCs and the moderating role of trust, particularly in politically unstable regions. TCE posits that firms attempt to minimize transaction costs, mitigate uncertainty, and enable stability in inter-firm relations (Humphrey & Strange, 2019). The DCV serves as the primary lens for understanding how firms adapt, recover, and thrive in dynamic environments (Bustinza et al., 2019; Teece et al., 1997; Teece, 2007). While these perspectives are often treated as distinct, we argue they are complementary. In politically unstable regions, suppliers must balance the stability offered by TCE-governance mechanisms with the adaptive capabilities emphasized by DCV. In the rest of the section, we further unpack our theoretical integration of TCE and DCV perspective to explain the link between GVC governance, resilience, and Trust.

2.1. GVC governance and resilience

GVC governance can be defined as a process through which leading actors in the GVC dictate, implement, and monitor the requirements that others in the GVC follow (Gereffi et al., 2005; Kano and Oh, 2020). Gereffi et al. (2005) developed a typology of GVC governance inter-firm linkages, which include market, modular, relational, captive, and hierarchy. These governance linkages are underpinned by varying levels of three governance mechanisms: task codification, managing task complexity, and supplier capability. Task codification formalizes activities with explicit rules and standards, ensuring consistency and quality

(Gereffi et al., 2005; Strange and Humphrey, 2019). Managing task complexity refers to the level of intricacy and sophistication involved in performing specialized tasks within the value chain (Choksy et al., 2024; Choksy, 2015). Finally, supplier capability denotes suppliers' technological capacity, competency, and resources to effectively perform their roles and responsibilities within the GVC and meet buyers' demands.

A growing body of research examines how GVC governance structures influence a firm's capacity to adapt to environmental disruptions (Choksy et al., 2022; Islam and Chadee, 2024; Verbeke et al., 2021). These studies highlight a focus on resilience in response to external supply chain threats (Gereffi, 2022; Kano et al., 2022). From the DCV perspective, resilience includes anticipating, absorbing, adapting, and transforming to maintain operational continuity (Ali et al., 2022; Sabahi and Parast, 2020). Most insights on resilience come from focal firms (Ambulkar et al., 2015; Chowdhury and Quaddus, 2016). Literature mainly examines how focal firms reduce disruptions, overlooking resilience cultivation at the source of disruptions. This viewpoint does not fully consider the upstream supplier's context, especially in politically unstable areas where many disruptions begin (Wieland & Durach, 2021). In these regions, supplier resilience is not just about overcoming disruptions, but also about maintaining operations amid ongoing instability and adapting to GVC buyer demands. Grounded in the DCV, supplier resilience in GVCs is defined as suppliers' ability to respond to disruptions and adapting to changing GVC requirements (Ali et al., 2022; Bustinza et al., 2019; Choksy et al., 2022).

Some studies contested the notion that resilience in GVCs is inherently determined by fixed governance structures like relational or modular types (Islam and Chadee, 2024; Kano et al., 2022). While GVC governance frameworks classify well, they fail to capture the dynamic strategies firms use to address environmental disruptions. This study draws on the recent IB perspective on GVC governance adaptation (Islam and Chadee, 2024; Kano et al., 2022), viewing governance as a dynamic, context-sensitive response rather than a fixed structure. Additionally, we incorporate a supplier agency perspective, suggesting that while suppliers' actions are influenced by GVC governance, they can choose diverse survival strategies (Choksy et al., 2017; Choksy et al., 2024). These concepts underpin our understanding of how GVC governance mechanisms, codification, complexity, and supplier capability relate to supplier resilience.

Kano et al. (2022) argue that resilience depends on adaptable managerial governance, contrasting with static governance structures, to address disruptions like crises or political instability. Instead of just structural changes in GVCs, such as diversifying suppliers or reshoring, managerial adaptations focus on redefining coordination and control to align lead firms with suppliers, tackling long-term vulnerabilities. Similarly, Islam and Chadee (2024) state that overcoming disruptions, like the COVID-19 pandemic, necessitates governance mechanisms that are robust yet adaptable, allowing quick responses to challenges and supporting value chain resilience, particularly for developing country suppliers. McWilliam et al. (2020) note the vague nature of how governance mechanisms affect supplier outcomes, stressing the need for responsive governance to handle disruptions. Verbeke et al. (2021) also highlight the importance of understanding governance in uncertain environments. However, the specific effects of governance mechanisms on resilience in unstable regions remain underexplored.

We integrate DCV and TCE perspectives to explore how codification, managing task complexity, and supplier capability address political instability and foster resilience. TCE suggests GVC codification formalizes transaction processes, reduces ambiguity, and costs by improving information exchange (Choksy, 2015; Sinkovics et al., 2019). From a DCV viewpoint, codification, such as ongoing documented client feedback, aids information transfer, enabling suppliers to seize opportunities and manage disruptions. High task complexity demands strong oversight (Lema et al., 2018; Lema, 2011). TCE indicates that coordination reduces uncertainty, helping suppliers clarify expectations. However, governance efficiency cannot suffice amid political uncertainty;

adaptive capacities are crucial for resilience in meeting changing demands (Choksy, 2015; Sinkovics et al., 2019). Supplier capability mitigates governance risks by ensuring suppliers have the skills to avoid disputes. From a DCV perspective, competence fosters continual learning through joint product development and real-time problem-solving (Choksy et al., 2024). Taken together, TCE explains the importance of efficiency and minimizing transactional risks through codification and oversight in managing task complexity, while the DCV underscores the need for adaptive capabilities and continuous learning, especially under political uncertainty, enabling suppliers to move beyond mere efficiency to genuine resilience.

2.2. Trust in GVCs

In GVCs, where diverse actors collaborate across geographical and organizational boundaries to create value-added products or services (Gereffi et al., 2005; Kano and Oh, 2020), trust is often conceptualized as an imperative relationship facilitator (Pasquali & Alford, 2022). However, less is known about the “dark side” of trust in GVCs. Existing literature documents the positive roles of trust in GVCs but often neglects its potential negative aspects, particularly when suppliers face increased geopolitical risks (e.g., Sinkovics et al., 2021). The “dark side” of trust, marked by complacency, exploitation, and reduced vigilance, indicates that trust isn’t always beneficial. This oversight fails to recognize how overreliance on trust or misaligned trust expectations can create vulnerabilities, leading to inefficiencies or exploitation within GVCs (Villena et al., 2020). Excessive trust between partners can lead to unbalanced investments, creating vulnerabilities and delaying resolution of issues linked to asset specificity if expectations aren’t met or trust isn’t reciprocated (Verbeke et al., 2021; Villena et al., 2011; Villena et al., 2020). Such scenarios expose firms to risks from asymmetric trust dynamics and unexpected obstacles in collaboration (Oliveira et al., 2019; Benito et al., 2019). Recognizing and managing trust’s complexities, including its downsides, is vital for the integrity and effectiveness of GVCs. Our study aims to understand trust’s negative moderation role from the supplier’s perspective.

Particularly, we draw upon Sinkovics et al. (2021), who demonstrate that high inter-firm trust may suppress supplier innovation and upgrading under conditions of institutional asymmetry. This study explores the duality of trust in TCE and DCV. Trust decreases transaction costs by fostering cooperation and reducing opportunism, but excessive trust leads to complacency, lack of vigilance, and underinvestment in governance. Verbeke et al. (2021) indicate that over-reliance on trust can worsen bounded reliability and create vulnerabilities. Pasquali and Alford (2022) note that trust operates differently in North-South versus South-South GVCs. North-South GVCs benefit from stronger institutions, showing higher competence trust and rigorous monitoring. In contrast, South-South GVCs have limited competence trust because of weaker institutional mechanisms, which can create a false sense of reliability and increase vulnerabilities for GVC suppliers. DCV emphasizes that trust enhances adaptive capabilities through collaboration and knowledge sharing, but too much trust can hinder capability development by fostering dependency and reducing proactive investments (Choksy, 2015). For example, Choksy (2022) reported that socio-sustainable suppliers faced significant losses during the pandemic lockdown due to excessive reliance on relational trust with large retailers. Nevertheless, they focused on economic and social upgrades, resilience building through sustainability, and improving working conditions during the crisis.

3. Hypotheses development

3.1. Governance mechanisms and supplier resilience

Gereffi et al. (2005) emphasize that the governance structures of GVCs involve inherent trade-offs. For example, while codification

enhances process standardization and clarity, it may limit the supplier’s ability to innovate due to operational rigidity. Likewise, complexity, although fostering sophisticated and tailored outputs, can burden supplier resources and escalate operational risks, particularly in unstable regions. Supplier capability, while improving the supplier’s capacity to meet diverse buyer demands, may require higher investments in skills and infrastructure, potentially increasing vulnerability to external disruptions.

Drawing from Kano et al. (2022), the adaptability of managerial governance in crisis response underscores the need to balance these trade-offs to bolster resilience. The challenge lies in managing the trade-offs among these variables to achieve optimal resilience. Our study argues that the traditionally viewed trade-offs in codification, complexity, and capability must be reassessed for politically unstable regions. Drawing upon TCE and DCV, we address this balance between the stability and adaptability of codification, managing task complexity, and supplier capability. This insight transforms the understanding of governance by emphasizing the need for a dynamic balance of governance structures instead of rigid adherence to predefined models. Below, we explore the link between the three governance variables (task codification, managing task complexity, and supplier capability) and resilience before we move on to the moderating role of trust.

3.1.1. Task codification and supplier resilience

Codification of tasks can enhance resilience by standardizing processes, enabling compliance, and facilitating quicker adaptation. The software industry relies on precise task codification for managing distributed workforces and aligning cross-border operations. In politically unstable contexts, codification is crucial; disruptions from travel restrictions necessitate standardizing knowledge transfer to maintain client coherence (Choksy, 2015). This ensures project execution without face-to-face interactions, thus reducing the risks of client disengagement. Standardized protocols enable swift problem-solving and resource reallocation, reducing recovery time and operational downtime (Cepeda & Vera, 2007). However, codification can also reduce agility and flexibility, particularly in a high-tech industry like software development, where technological knowledge, especially related to software design and architecture, changes rapidly (Choksy, 2015). Over-reliance on codification can lock suppliers into structural rigidities and hinder their ability to respond to sudden changes or the emergence of disruptions. For example, Islam and Chadee (2024) found that Bangladeshi suppliers’ strict compliance with codified agreements made it difficult for them to handle PPE production quickly during the pandemic crisis.

Drawing upon both TCE and DCV perspectives, we argue that in regions facing political instability, a lead firm’s ability to codify, standardize, and explicitly document software requirements is critical for efficient knowledge transfer, risk mitigation, and adjustment to sudden disruptions or a changing external environment (Islam and Chadee, 2024; Sinkovics et al., 2019; Verbeke et al., 2021). From a TCE perspective, during political instability, codification compensates for a weaker institutional context and unreliable legal frameworks by ensuring that suppliers have a clear framework for complying with contractual requirements (Sinkovics et al., 2019). For example, Sinkovics et al. (2019) report that OSPs in the adverse political environment were able to utilize ISO certification to reassure clients of their ability to meet GVC demands on time. From a DCV perspective, codification helps adjust to sudden disruptions or a changing external environment. For instance, Choksy et al. (2022) found that lead firms’ reliance on codification as a primary governance mechanism enhanced the adaptive capacity of socio-sustainable suppliers to engage in bridging strategies during the pandemic crisis and, as a result, achieved both economic and social upgrading. Similarly, Kano et al. (2022) found that firms investing in digital codification and predictive analytics were able to prepare for supply chain disruption through anticipation and proactiveness. Thus, we suggest that:

H1. *The codification of tasks is positively associated with supplier resilience in GVCs.*

3.1.2. Managing task complexity and supplier resilience

Managing task complexity in GVCs refers to the degree of difficulty associated with processing, interpreting, and applying the knowledge required for performing a task in GVCs (Kano et al., 2022). Software projects are often complex due to customized solutions and iterative development (Choksy et al., 2024). Political instability increases this complexity, creating uncertainties in resources and operations (Sinkovics et al., 2019). In knowledge-intensive sectors like the software industry, it is challenging for firms to transfer complex knowledge (e.g., software architecture or user experience in software development) (Choksy et al., 2024; Choksy, 2015). Codification may be useful to communicate more defined GVC requirements, but it is not sufficient to transfer when task complexity is high (Choksy, 2015; Gereffi et al., 2005). High task complexity necessitates frequent coordination and communication (Buckley et al., 2019), supported by both formal and informal socialization mechanisms (cf. Khan et al., 2015). Although high task complexity exacerbates challenges that can negatively affect resilience by increasing coordination costs, misalignment risks, and susceptibility to disruptions, managing task complexity through effective governance mechanisms can alleviate these issues (Verbeke et al., 2021).

Managing task complexity becomes even more difficult and costly in politically unstable regions characterized by unreliable infrastructure or governance (Sinkovics et al., 2019). In such regions, disruptions like violence and local strikes can misalign expectations and execution of complex projects. Furthermore, political instability can lead to restricted travel, limited face-to-face customer interactions, and the cancellation of physical visits between lead firms and their suppliers (Manning, 2014). According to the TCE perspective, a supplier's coordination with GVC buyers before the project initiates helps reduce ex-ante uncertainty by allowing suppliers to gain a clear understanding of buyer requirements and specialized knowledge. This, in turn, enables suppliers to fulfill the initial requirements and ensure GVC compliance. Sinkovics et al. (2019) report that Pakistani offshore service providers (OSPs) facing political instability leveraged a mix of in-person meetings with clients and ICT-based coordination tools to understand client vision and requirements for the software app despite travel restrictions and disruptions in legal enforcement mechanisms (Sinkovics et al., 2019). From a DCV perspective, once the project is underway, continued coordination allows suppliers to reduce ex-post uncertainty by adapting to evolving requirements and responding to changes in specialized knowledge. This adaptability ensures that suppliers remain flexible and responsive to shifting market conditions, regulatory environments, or buyer expectations, ultimately strengthening their ability to navigate political instability and demonstrate resilience. For example, Kano et al. (2022, p.35) explain that ASML, which designs and manufactures technology for producing computer chips, ensures that suppliers responsible for managing complex semiconductor components are given continuous technical support, facilitating the suppliers' ability to meet changing buyer requirements while maintaining product quality standards. The preceding discussion leads us to suggest that:

H2. *Managing task complexity is positively associated with suppliers' resilience in GVCs.*

3.1.3. Supplier capability and supplier resilience

Researchers have extended the inward-looking perspective of capabilities to the interfirm level, proposing that partner capabilities can significantly shape a firm's competitive advantage (Santos & Eisenhardt, 2005). Supplier relationships for sourcing are common as firms specialize in areas of strength and leverage external partners' capabilities to address weaknesses. Supplier capability is defined as the operational and technical skills that reflect a client's knowledge and ability

to efficiently execute a respective business process.

Supplier capability decreases bounded rationality risks, allowing suppliers to clearly define product requirements and maintain quality control. For instance, Sinkovics et al. (2019) report that during political instability, suppliers lose clients due to negative media portrayals of the country's political situation. In response, suppliers highlighted their expertise in software design and user experience on smaller client projects, thereby enhancing their portfolio and credibility within the global industry. This transition exemplifies a TCE-driven governance system, as suppliers' capabilities provide contractual stability and minimize procurement risks. While supplier capability development increases governance efficiency, it may also pose hazards if overemphasized as a governance instrument. Over-specialization, in which suppliers engage extensively in buyer-dictated manufacturing processes, can impair flexibility and increase sensitivity to demand fluctuations, resulting in lock-in consequences that limit supplier autonomy (Islam & Chadee, 2024). Similarly, buyer-driven upgrading may lead to supplier reliance, since suppliers lack the strategic decision-making capacity to pivot independently in the face of volatility (Gereffi et al., 2022). These concerns underscore the necessity for suppliers to strike a balance between efficiency-driven governance structures (TCE) and strategic flexibility (DCV) to prevent rigidities that might impede reaction to unexpected shocks.

From the standpoint of DCV, supplier capability development extends beyond cost reduction and governance control; it serves as an adaptive mechanism for continually updating both technology and market capabilities. For example, Choksy et al. (2022) examine the role of adaptive suppliers who recognized that demand for garment products was low during the pandemic. Instead, demand for home textiles was strong, notably in GVCs run by digital platform businesses such as Amazon and Ali Baba. Adaptive suppliers' detection of new goods and markets enabled them to transition to home textiles GVCs organized by platform firms. These examples demonstrate how supplier capability promotes resilience not only by enhancing governance efficiency (as per the TCE), but also by allowing businesses to pivot, innovate, and diversify (as emphasized in DCV) in the face of external shocks.

Therefore, to further strengthen the connection between supplier capability and resilience, it is important to emphasize reactive flexibility and proactive adaptation. Supplier capability can empower firms to anticipate and respond tactically to political or environmental volatility by reconfiguring operations ahead of time (Henisz, 2016). For instance, highly capable suppliers may shift production lines, rotate specialized teams, or develop contingency inventories in anticipation of disruptions. This forward-looking orientation enables them to realign resources and processes to mitigate risk before it materializes (Vecchiato & Roveda, 2010). Such proactive adaptation distinguishes mere operational competence from strategic resilience. Thus, supplier capability plays a vital role not only in detecting and responding to market signals (as shown in the shift to home textiles during the pandemic) but also in actively shaping the trajectory of responses by preparing for instability in advance. This proactive stance is where supplier capability becomes a true enabler of resilience in dynamic global value chains. Based on the above, we propose the following:

H3. *Supplier capability is positively associated with supplier resilience in GVCs.*

3.2. The moderating role of trust

Trust in collaborations between lead firms and suppliers in GVCs is a crucial component of inter-organizational relationships (Lew et al., 2016). This trust goes beyond faith in integrity or reliability; it signifies mutual confidence in interactions, agreements, and shared information. It embodies the qualitative aspect that ensures smooth transactions and cooperation towards shared goals (Zaheer et al., 1998).

Task codification strengthens supplier resilience by establishing

clear standards and protocols for operational processes. However, in GVCs, high levels of trust between lead firms and suppliers can substitute for codification. With strong trust, suppliers may rely less on detailed processes due to their confidence in interpreting vague instructions. Thus, excessive trust can foster complacency, causing suppliers to overlook the importance of standardized procedures (Sinkovics et al., 2021; Villena et al., 2020). Consequently, neglecting compliance with established standards may compromise operational robustness and hinder adaptability in politically volatile environments (Oliveira & Lumineau, 2019).

Task codification enhances supplier resilience through standardized processes and reduced ambiguity, but trust may lessen the need for codification's effectiveness. This relationship can be understood by examining how trust moderates the dual roles of DCV and TCE. Codification strengthens DCs, providing a foundation for quick adaptation during disruptions. However, high trust leads firms to favor relational flexibility (Bodlaj et al., 2017) over strict codified processes, potentially hindering dynamic responses to shocks. While trust promotes adaptability, reliance on it may weaken a supplier's capacity to utilize codified DCs effectively. Codification lowers transaction costs by clarifying processes, while trust also minimizes oversight needs. In high-trust relationships, the benefits of codification decrease, risking overreliance on trust and underinvestment in formal systems. Trust's role in reducing transaction costs may lead to neglect of formal governance in complex tasks, increasing vulnerability to disruptions. In volatile environments, sudden policy shifts or instability heighten risks for firms relying on trust. These situations 'stress-test' informal structures, revealing that excessive trust without monitoring increases vulnerability. This highlights trust's dark side, where cooperation mechanisms, under stress, may turn into sources of risk (Gargiulo & Ertug, 2006). Additionally, supplier capabilities like flexibility, learning, and innovation enhance resilience as key DCs (Vanpoucke et al., 2014).

Furthermore, trust-based relationships often facilitate greater flexibility and adaptability among GVC participants (Faruquee et al., 2021). When trust levels are high, suppliers may have more latitude to deviate from prescribed procedures or innovate new solutions on the fly. Likewise, trust fosters open communication and collaboration between lead firms and suppliers, which can mitigate the need for extensive task codification (Can Saglam et al., 2022). Suppliers who lean towards personal relationships at the expense of following codified guidelines risk introducing inconsistencies, errors, and inefficiencies in their operations (Villena et al., 2011; Villena et al., 2020). This deviation can potentially weaken resilience by creating vulnerabilities in the face of disruptions (Plank & Staritz, 2015).

Similarly, high levels of task complexity in GVCs often necessitate frequent coordination, prompt progress reporting, and adaptability from suppliers to navigate challenges effectively, especially in politically unstable regions (Choksy et al., 2024). However, overly emphasizing trust among partners may lead suppliers to prioritize interpersonal relationships and trust-based decision-making over addressing the intricacies posed by complex tasks (Oliveira and Lumineau, 2019; Villena et al., 2011). Trust fosters open communication channels, facilitating a more efficient exchange of information, clarification of requirements, and alignment of expectations (Can Saglam et al., 2022). As a result, it may lessen the need for managing task complexity in supplier resilience because, in high-trust environments, handling task complexity can become less critical for supplier resilience.

A trust-centric environment may inadvertently divert attention from ongoing efforts to enhance supplier capabilities (Sturgeon, 2009). Given the "dark side" of trust as discussed above (Sinkovics et al., 2021), there may be a tendency for lead firms to rely excessively on trust as a substitute for leveraging supplier capabilities in high-trust GVCs. Trust between lead firms and suppliers is essential for collaboration and efficiency. However, in politically unstable regions, over-reliance on trust creates vulnerabilities, especially when governance mechanisms and supplier independence are underdeveloped. For example, firms

relying heavily on trust may underinvest in formal risk mitigation strategies, assuming partners will handle disruptions (Siegrist & Bearth, 2021). Suppliers might also rely excessively on existing trust networks, ignoring the proactive development of capabilities that could enhance their positions in GVCs (Khan et al., 2015). Consequently, suppliers struggle to negotiate better contractual terms in GVC (Sinkovics et al., 2021), limiting their resilience to navigate political uncertainties and the negative country of origin effects in GVC (Sinkovics et al., 2019). Additionally, high trust may lead lead firms to overlook monitoring supplier activities, which can reduce the influence of supplier capability on resilience by minimizing opportunities to leverage those capabilities. This discussion leads us to suggest the following:

H4a. *Trust negatively moderates the relationship between task codification and supplier resilience.*

H4b. *Trust negatively moderates the relationship between managing task complexity and supplier resilience.*

H4c. *Trust negatively moderates the relationship between supplier capability and supplier resilience.*

Fig. 1 presents the conceptual model illustrating the hypothesized relationships between governance variables, trust, and resilience, as outlined in the preceding discussion.

4. Methods

4.1. Research context

Political instability poses significant challenges to the economic growth of South Asia, which is home to 1.9 billion people across India, Pakistan, Nepal, Bangladesh, Sri Lanka, and Bhutan. Frequent policy changes, security issues, and strained relations hinder effective economic strategies and damage the region's global image (Dutt and Mitra, 2007; Nwe et al., 2018). This instability affects industries, including the software sector, by discouraging foreign direct investment (FDI) and restricting access to global markets due to increased investment risks (Perera, 2019). Complicated visa processes and security issues further exacerbate these challenges, limiting cross-border talent mobility, a crucial factor for software innovation and collaboration (Rasul & Manandhar, 2009). Media portrayals emphasizing unrest reinforce these perceptions, diminishing the region's appeal as a hub for technology development and innovation (Rathnayake, 2022).

South Asia significantly contributes to global software outsourcing thanks to a skilled workforce, cost-effectiveness, scalability, and quality solutions. This sector has rapidly grown, with India being dominant and countries like Pakistan, Vietnam, and the Philippines gaining popularity (Arshad et al., 2024). Our research focuses on India and Pakistan, accounting for 86 % of South Asia's 1.9 billion population and serving as key software industry hubs. However, political instability affects their economic activities, with Pakistan facing more severe challenges than India (Hardgrave, 2019; Jaffrelot, 2015). These shared characteristics make India and Pakistan archetypal representatives of the South Asian region.

In the specific context of the software industry, political instability in South Asia has significantly influenced this sector, leading to various operational challenges, such as supply chain disruptions, market volatility, and reduced client confidence. For example, Sahay et al. (2003) found that political instability deters foreign direct investment in the software sector across the region. Similarly, Sinkovics et al. (2019) highlighted that local conditions in Pakistan, particularly political instability, posed substantial barriers to the growth of the software industry.

Political instability in India has created policy uncertainties and regulatory challenges that hinder software industry growth (Rathnayake, 2022). Negative perceptions of India's pandemic response, economic volatility, and political instability have undermined investor confidence,

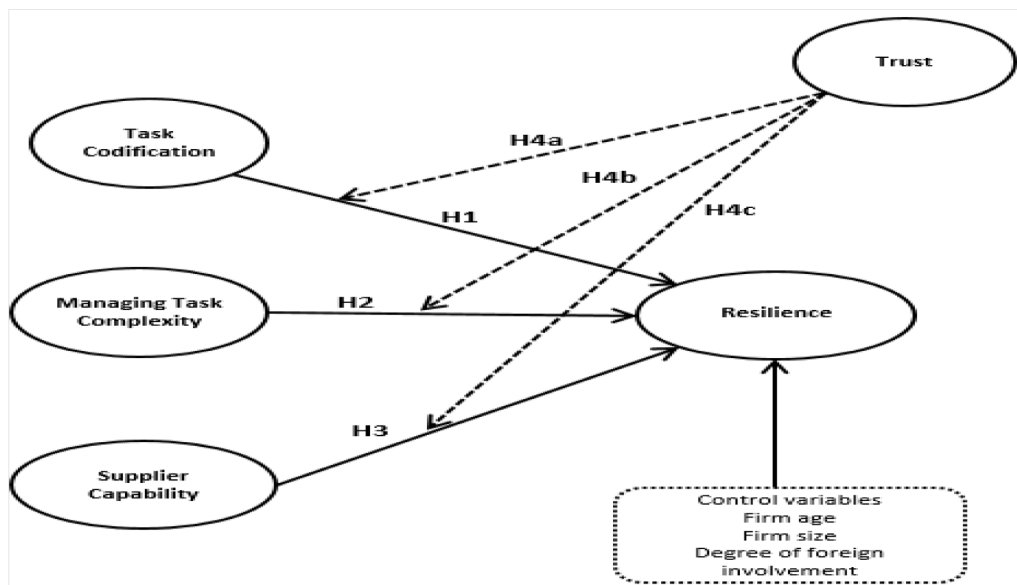


Fig. 1. Conceptual model.

making it difficult for software companies to secure funding. Visa restrictions and GVC disruptions limited the mobility of skilled professionals, which is essential for software service operations for international clients, leading to project delays and hindering cross-border collaborations (Rathnayake, 2022; Vevek and Sivaprakash, 2021). India's software industry, particularly firms providing services to international clients, has faced difficulties due to political instability and policy uncertainties. A study examining the link between political uncertainty and corporate investments in India found that such instability can result in lower investment activities among firms, including those in the software sector. This reluctance arises from concerns over possible policy changes and regulatory unpredictability, which can negatively impact long-term planning and operations.

Pakistan's political instability has created challenges for the country's local tech sector, undermining investor trust and leading to regulatory uncertainty. As a result of bureaucratic red tape, inconsistent government regulations, and security concerns, this uncertainty has hindered innovation and inhibited sector growth (Tariq & Yunus, 2022). The perception of political instability has adversely affected Pakistan's tech industry, deterring foreign direct investment and limiting partnerships with international companies (Cheema, 2016; Sinkovics et al., 2019). Thus, South Asia, encompassing India and Pakistan, provides a fitting context for exploring the relationship between GVC governance and supplier resilience, as well as the moderating role of trust.

4.2. Sampling and data collection

This research focuses on South Asian software companies in India and Pakistan that provide custom software and product development services for foreign clients. Data was collected from May to August 2020 through online surveys, using random sampling via social media and technology platforms. A research assistant (RA) was hired for the process. Initial searches on LinkedIn and Clutch.co indicated that many companies catered to international clients, filtered under "software services," "mobile development," and "web development." Inclusion criteria required firms to provide services to international clients, derive at least 50 % revenue from exports, employ between 50 and 300 personnel, and be past the startup phase based on public information. Companies serving only domestic clients or lacking an online presence were excluded.

The RA, trained in Qualtrics, managed data collection by generating

personalized survey links to ensure data security. Initial emails introduced the study and offered an executive report as an incentive. The sampling frame was expanded by using the Pakistan Software Houses Association (PASHA) database to include companies not listed on Clutch.co. After the first wave of questionnaires, we sent a reminder to those respondents who had not yet completed the survey.

Data from 150 companies was gathered, discarding 50 invalid responses, which led to a final sample of 100. As noted by Scheaf et al. (2023), response rates in the social sciences have declined, and our research faced similar challenges, likely due to the COVID-19 pandemic affecting firms' operational priorities and willingness to participate. Nevertheless, we assessed non-response bias using wave analysis, comparing first-wave respondents with second-wave respondents (Armstrong & Overton, 1977). Respondents were categorized into early and late groups, and t-tests were conducted to compare key variables such as firm size, firm age, and degree of foreign involvement. The results showed no significant differences between the two groups ($p > 0.05$), suggesting no evidence of non-response bias.

4.3. Operationalization and measurement

We operationalize our constructs by drawing on both TCE and DCV perspectives based on existing studies and adapting to the context of software development suppliers connected to GVCs. Our approach to GVC governance mechanisms was informed by qualitative interviews conducted by the principal researchers in the pre-survey phase. These interviews with software industry experts provided critical insights into task codification, managing task complexity, and supplier capability, which were then used to adapt and refine items from established studies. This iterative process ensured that the constructs were contextually relevant and grounded in the realities of the software industry. We measure our constructs using reflective multi-item scales adapted from validated and relevant articles in top journals that support content validity. Items are evaluated on a six-point Likert scale (1 = strongly disagree, 6 = strongly agree).

Resilience is measured using four items modified from the studies of Gölgeci and Kuivalainen (2020) and Chowdhury and Quaddus (2016). The resilience items aim to understand firms' ability to adequately respond to unexpected disruptions, quickly return to their original state after being disrupted, move to a new, more desirable state after being disrupted, and deal with the financial outcomes of potential disruptions.

Task codification relies on insights by Choksy et al. (2024), Sinkovics

et al. (2019), Özatağan (2011), and Liu et al. (2019), supplemented by qualitative interviews. While these studies provide concepts, they lack established scales for task codification. Using interview insights, we refined items to assess lead firms' capabilities in specifying software requirements and clarifying user needs. This involves providing documented feedback related to business domains, beyond mere technicalities. It also requires contextual knowledge of how software aligns with business models. In 2018, to ensure validity, we interviewed five software industry experts and five academics, refining survey items based on their feedback.

Managing task complexity draws on Xia and Lee (2005), Sinkovics et al. (2019), Choksy et al. (2024), and Liu et al. (2019), along with qualitative interviews. The items focus on coordinating with international clients to handle tacit knowledge about their business and software needs, ensuring alignment from the project's start. Given the dynamic nature of software tasks, timely coordination between buyer and supplier is vital due to potential requirement changes. Managing complex tasks requires collaboration with clients to improve the user experience concerning design and functionality. Managing task complexity is measured using three specific items, validated during the 2018 expert interviews to ensure they reflected the construct accurately in the context of software development within GVCs.

Drawing upon Choksy et al. (2024), Ozatagan (2011), Sinkovics et al. (2019), and qualitative interviews, we consider *supplier capability* as a multifaceted construct that includes active engagement in innovation, strategic product development, and technical design processes alongside major international clients. Supplier capability is measured with four items. Table A1 in the Appendix presents how the items for task codification, managing task complexity, and supplier capability constructs were developed by combining insights from existing literature and qualitative interviews to ensure conceptual clarity and contextual fit.

Our understanding of *trust* is based on Lew et al. (2016) on relational and contractual trust. Relational trust signifies the existence of a high level of trust characterizing the relationship between major international clients and the supplier. It encompasses the belief in each other's reliability and integrity, fundamentally shaping how both parties engage, communicate, and collaborate. Contractual trust refers to trust that both parties will adhere to the terms of the contract, which underlines the confidence each has in the other to fulfill agreed-upon obligations and responsibilities. Trust measurement is modified from the study of Lew et al. (2016).

Business performance, which is used for post-hoc analysis, is measured subjectively based on respondents' satisfaction with the firm's business performance. Five items are adapted from the studies of Liu et al. (2017) and Akhtar et al. (2019). Respondents were asked to indicate their degree of satisfaction with their business performance on the six-point Likert scale Table 2 presents all measurement scales.

Control variables include firm size, firm age, and degree of foreign involvement. Firm size is defined and operationalized as the total

number of full-time employees. We included firm size, as smaller firms, though lacking resources, can demonstrate resilience in adverse situations due to their shorter chain of command for decision-making (Ambulkar et al., 2015). Firm age is measured as the number of years since the establishment time of a firm. Firm age is used as a control variable because older firms generally have more experience, greater exposure to disruptions, and a higher capability to manage them, leading to increased resilience (Ambulkar et al., 2015). The degree of foreign involvement is measured as the ratio of a firm's foreign sales to total sales. A higher degree of foreign involvement can offer better and more flexible access to resources, access new markets, diversify revenue streams, and reduce the dependency on domestic markets, which in turn can affect resilience (Pühr & Mullner, 2022).

To validate the questionnaire's face validity, we followed Hardesty and Bearden's (2004) recommendation to involve expert judges by interviewing five academics and five software development managers. They commented on the survey's questions, leading to modifications for clarity. We conducted exploratory factor analysis (EFA) using SPSS, revealing that all factor loadings exceeded 0.5 and cross-loadings were below 0.3 (Comrey & Lee, 2013), validating the factor structure. The Kaiser-Meyer-Olkin (KMO) value was 0.729, above the 0.5 threshold, and Bartlett's test yielded a significance below 0.01 (Hair et al., 1998). These findings confirm the validity of our factor structure.

4.4. Common method variance

To address common method variance (CMV), we used procedural and statistical remedies. We examined item construction with practitioners and academics to enhance face validity and reduce ambiguity (Chang et al., 2010). Additionally, we applied statistical methods, including Harman's one-factor test, to investigate CMV following Chang et al. (2010) and Podsakoff et al. (2003). The unrotated principal component analysis findings revealed that the initial factor accounted for 26.91 % of the overall variance. This percentage falls below the commonly accepted threshold of 50 %, indicating a lack of significant CMV (Podsakoff et al., 2003). Additionally, we evaluated the full-collinearity variance inflation factors (VIFs) as a more robust test in PLS-SEM (Kock, 2015). VIFs of 3.3 or lower suggest the model can be considered free from CMV (Kock, 2015). Our analysis shows that all VIF values of the inner model were below the threshold value of 3.3, ranging from 1.291 to 2.372, further reaffirming the absence of any significant CMV problems.

5. Analysis and results

5.1. PLS-SEM analysis

We applied PLS-SEM to analyze our data using SmartPLS4 software. PLS-SEM was chosen as the most suitable data analysis technique for this

Table 1
Descriptive statistics.

Firm age	%	Firm size (full-time employees)	%	Main Export Locations	%	Size of major clients	%	Political stability indicator*	Percentile rank	Location for services	%
1–5 years	8.0 %	1–10	19 %	US	68 %	Large domestic or multinational enterprises	21 %	India Pakistan	18.40 5.19	International	89 %
6–10 years	51.0 %	11–50	55 %	UK	15 %	Medium-sized enterprises	35 %	US	47.64	Domestic	11 %
11–15 years	26. %	51–100	16 %	UAE	12 %	Small-sized enterprises/Start-ups	44 %	UK	61.32		
16–20 years	10 %	101–250	7 %	Australia	3 %			UAE	65.09		
20 + years	5 %	250 +	3 %	China	2 %			Australia China	76.89 27.83		

* Worldwide Governance Indicators (Year 2020).

Table 2
Measurement items and properties.

Construct Measure	Outer Loading	t-value
Task Codification (CR= 0.840, Cronbach's Alpha=0.745, AVE = 0.570)		
Our major international clients are able to specify detailed software requirements during the initial phase of the project.	0.833	17.755
Our major international clients are able to clearly specify user expectations.	0.796	12.833
Our major international clients provide concrete feedback on the software demos or the milestones delivered.	0.675	9.561
Our major international clients clearly codify any changes in software requirement.	0.704	9.561
Managing Task Complexity (CR= 0.874, Cronbach's Alpha=0.784, AVE = 0.699)		
We coordinate frequently with international clients to deal with specialized knowledge required for software development tasks.	0.854	11.775
We coordinate frequently with our major international clients to understand and clarify the initial software requirements	0.895	15.925
We coordinate frequently with our major international clients to cope with changing requirements during the latter phases of the project	0.754	5.225
Supplier capability (CR= 0.872, Cronbach's Alpha=0.812, AVE = 0.631)		
Our firm is engaged in the development of new product ideas with major international clients	0.710	3.638
Our firm is engaged in product definition with major international clients	0.841	5.162
Our firm is engaged in the analysis of product need with major international clients	0.813	4.488
Our firm is engaged in complex software engineering tasks necessary to transform design specifications into the actual software product	0.808	4.101
Resilience (CR= 0.883, Cronbach's Alpha=0.824, AVE = 0.655)		
Our firm is able to adequately respond to unexpected disruptions by quickly restoring its product flow.	0.779	13.881
Our firm can quickly return to its original state after being disrupted or impacted by a negative event	0.887	38.043
Our firm can move to a new, more desirable state after being disrupted or impacted by a negative event	0.838	19.211
Our firm is well prepared to deal with the financial outcomes of potential disruptions or negative events	0.723	6.658
Trust (CR= 0.927, Cronbach's Alpha=0.844, AVE = 0.864)		
The relationship with our major international clients is characterized by a high level of trust.	0.915	16.497
My company and our major international clients generally trust that each will stay within the terms of the contract.	0.944	17.231
Business Performance (CR= 0.882, Cronbach's Alpha=0.836, AVE = 0.600)		
Over the last 3 years, our company has gained higher level of international clientele loyalty compared to our major competitors	0.872	33.145
Over the last 3 years, our company has gained a higher level of international clientele satisfaction compared to our major competitors.	0.799	15.825
Over the last 3 years, our company has increased its sales from international clients relative to our largest competitor	0.781	15.658
Over the last 3 years, our company has increased its revenue from new partners or business	0.766	14.542
Over the last 3 years, our company has increased its expansion of internal business operations	0.792	16.250

Note: We included the business performance construct as it was utilized in the post-hoc analysis.

research for several reasons. First, due to its effectiveness in exploration and theory development, PLS-SEM is the most appropriate method for our study (Henseler et al., 2009). Hair et al. (2019, p.5) noted that researchers should employ PLS-SEM “when the research objective is to better understand increasing complexity by exploring theoretical extensions of established theories (exploratory research for theory development).” Accordingly, the exploratory aspect of our study is the primary rationale for selecting PLS-SEM. Additionally, prior studies have shown that PLS-SEM provides solutions when methods such as

CB-SEM yield inadmissible results or fail to converge, particularly with complex models and small sample sizes (Sarstedt et al., 2016). We developed a complex research model with numerous relationships, including both direct and moderated effects among the constructs, for which PLS offers robust analysis (Hair et al., 2017). Finally, PLS-SEM has the advantage of imposing minimal requirements on sample size to achieve sufficient statistical power (Hair et al., 2017). Our moderate sample size ($n = 100$) is adequate according to the “ten times” rule of PLS-SEM (Reinartz et al., 2009). However, Hair et al. (2017) argued that the ten times rule serves as a rough guideline and emphasized the importance of conducting a power analysis to determine the minimum required sample size. To ensure our study had an adequate sample size, we used G*Power software (Faul et al., 2007). As recommended by Hair et al. (2017), we set $\alpha = 0.05$, $\beta = 0.80$, effect size = 0.15, and the number of predictors as 4, consistent with our model. The analysis results indicated that the minimum required sample size is 85. Thus, a sample size of 100 is sufficient for this study.

5.2. Descriptive statistics

Table 1 shows the descriptive statistics for sample firms. Results reveal that 59 % are under 10 years old. Size-wise, 97 % have fewer than 250 full-time employees, with 74 % employing fewer than 50. This mirrors the software industry in emerging markets like South Asia (India, Pakistan), where small firms dominate. This trend is not exclusive to South Asia but common in many emerging markets, allowing for broader applicability of our findings. Regarding export regions, 68 % export to the U.S., followed by the UK and UAE, with two firms exporting primarily to Australia and one to China. For client size, 44 % are small/startup firms, 35 % are medium-sized, and 21 % are large corporations. Most (89 %) firms serve international clients, while 11 % cater to local clients. We also present political stability indicators for the supplier firms and clients involved. Both Pakistan and India exhibit low political stability compared to the U.S., U.K., UAE, and Australia, where 98 % of clients are located. This disparity likely undermines trust in these suppliers, as clients from stable regions perceive more risk in engaging with them, posing a challenge for firms in India and Pakistan. As a result, these firms must invest in relationship building to enhance client confidence.

5.3. The assessment of the measurement model

We assessed the measurement model with reflective indicators by evaluating reliability and validity. Internal reliability is assessed by using composite reliability (CR). The CR scores were all above 0.7, ranging from 0.840 to 0.928, which suggested that the composite measurement items had sufficient reliability (Hair et al., 2017). Cronbach's alpha values for each construct are above 0.7, ranging from 0.745 to 0.863, which also confirms the reliability of the constructs. We also assessed the reliability of each indicator by using the indicators' outer loadings (Hair et al., 2011). While the PLS-SEM literature widely recognizes 0.7 as the recommended cut-off point for outer loadings (e.g., Hair et al., 2017), it is also acknowledged that this threshold is not absolute, especially in models with an exploratory focus. Chin (1998) suggested that items with loadings above 0.6 can be retained when they contribute to the construct's content validity and reliability in exploratory studies. All items in our model exhibit outer loadings exceeding 0.7, except for “Task codification 3”, which falls slightly below this threshold. We chose to retain this item to preserve the construct's content validity while maintaining the exploratory integrity of the study.

The validity of the constructs was assessed by examining both convergent and discriminant validity. Following Fornell and Larcker (1981), we investigated convergent validity, which indicates that an average variance extracted (AVE) value above 0.5 confirms sufficient convergent validity. All constructs have AVE values exceeding 0.5, ranging from 0.570 to 0.864, thereby confirming convergent validity.

Discriminant validity was assessed using the Fornell-Larcker and Heterotrait-Monotrait (HTMT) criteria. [Fornell & Larcker's \(1981\)](#) criteria for discriminant validity suggest that the correlation among constructs should be less than the square root of the AVE for each construct. As shown in [Table 3](#), the AVE values of all constructs are greater than each construct's highest squared correlation with any other construct, confirming that discriminant validity is established. Additionally, we utilized HTMT ratios of correlations to evaluate discriminant validity ([Henseler et al., 2015](#)). The HTMT results presented in [Table 4](#) are all below the threshold of 0.90, further confirming discriminant validity.

5.4. Hypotheses testing results

After validating a reliable measurement model, we assess the structural model's predictive power by examining the variance explained (R^2) of endogenous constructs. R^2 values of 0.67, 0.33, and 0.19 in PLS path models are classified as substantial, moderate, and weak, respectively. The R^2 value for resilience is 0.328, indicating moderate predictive power ([Hair et al., 2017](#)).

We also evaluate the effect size (f^2 , the change in R^2) to investigate the impact of independent latent variables on dependent variables ([Hair et al., 2017](#)). f^2 values of 0.02, 0.15, and 0.35 are small, medium, and large effect sizes ([Chin, 2009](#)). The effect sizes of task codification, managing task complexity, and supplier capability on resilience are 0.137, 0.074, and 0.001, respectively, demonstrating small effects. The small effect sizes of task codification, complexity, and supplier capability on resilience indicate limited practical influence. While task codification and complexity have relatively greater impacts, supplier capability shows minimal influence. This suggests that other factors like organizational culture and agility may play a more significant role in fostering resilience ([Piya et al., 2022](#)).

We used a bootstrapping technique to test hypotheses and evaluate the significance of the path coefficients ([Hair et al., 2017](#); [Henseler et al., 2009](#)), conducting 5000 resamplings of 100 observations. The results are presented in [Table 5](#) and [Fig. 2](#).

The path coefficients for task codification, managing task complexity, and supplier capability in relation to resilience are 0.339 ($t = 3.880$, $p < 0.001$), 0.269 ($t = 2.328$, $p < 0.05$), and 0.004 ($t = 0.047$, $p = 0.962$), respectively, supporting H1 and H2 while rejecting H3. The moderation effects of trust are tested with H4a, H4b, and H4c. The path coefficient indicating trust's influence on the relationship between task codification and resilience is -0.159 ($t = 2.079$, $p < 0.05$), supporting H4a. To illustrate this interaction effect, we present the simple slopes graph in [Fig. 3](#). In contrast, the path coefficient from trust regarding managing task complexity and resilience is 0.159 ($t = 1.465$, $p = 0.143$), rejecting H4b. Additionally, trust's path coefficient on the relationship between supplier capability and resilience is 0.093 ($t = 0.782$, $p = 0.434$), which also rejects H4c. We controlled for the effects of firm size, firm age, and degree of foreign involvement. The path coefficients from firm age, firm size, and degree of foreign involvement to resilience are 0.033 ($t = 0.341$, $p = 0.733$), 0.002 ($t = 0.023$, $p = 0.953$), and -0.006 ($t = 0.059$, $p = 0.982$), respectively. Thus, the results indicate no significant paths between control and endogenous variables. The findings in [Table 5](#) demonstrate that among the three moderation relationships, only the one between task

Table 3
Discriminant validity assessment (Fornell-Larcker Criterion).

Constructs	1	2	3	4	5
1.Task Codification	0.755				
2.Managing task complexity	0.164	0.836			
3.Supplier Capability	0.162	0.164	0.794		
4.Resilience	0.43	0.332	0.182	0.809	
5.Trust	0.141	0.263	0.342	0.275	0.929

Table 4
Discriminant validity assessment (Heterotrait-Monotrait Ratio (HTMT)).

Constructs	1	2	3	4	5
1.Task Codification					
2.Managing task Complexity	0.260				
3.Supplier Capability	0.215	0.249			
4.Resilience	0.526	0.406	0.202		
5.Trust	0.182	0.322	0.405	0.325	

Table 5
Results of structural model testing.

Relationships	path coefficient	t values	p values	sig
H1: Task Codification → Resilience	0.339***	3.880	0.000	Yes
H2: Managing Task Complexity → Resilience	0.269**	2.328	0.020	Yes
H3: Supplier Capability → Resilience	0.004 n.s.	0.047	0.962	No
H4a: Trust* Task Codification → Resilience	-0.159^{**}	2.079	0.038	Yes
H4b: Trust* Managing Task Complexity → Resilience	0.159 n.s.	1.465	0.143	No
H4c: Trust* Supplier Capability → Resilience	0.093 n.s.	0.782	0.434	No
Firm age → Resilience	0.033	0.341	0.733	No
Firm size → Resilience	0.002	0.023	0.953	No
Degree of foreign involvement → Resilience	-0.006	0.059	0.982	No

*** $p < 0.001$; ** $p < 0.05$; * $p < 0.10$; n.s., not significant.

codification and resilience is significant. This shows that the positive relationship between task codification and resilience can be negatively influenced by trust.

The link between resilience and business performance is well-documented in the literature. Resilience is widely recognized as crucial for thriving in dynamic environments, enabling firms to take robust, situation-specific, and transformative actions when faced with unexpected and severe challenges that may jeopardize their long-term survival ([Gölgeci & Kuivalainen, 2020](#)). For instance, [McCann et al. \(2009\)](#) suggest that resilience enhances competitiveness during turbulent periods, ultimately driving improved performance. Therefore, we did not explicitly hypothesize this relationship in our model. Nevertheless, we performed a post-hoc analysis to investigate the connection between resilience and business performance in political instability. Our findings reveal a significant positive relationship, with a path coefficient of 0.431 ($t = 6.054$, $p = 0.00$), demonstrating that resilience significantly enhances business performance among software suppliers operating in politically unstable regions.

We followed [Sarstedt et al. \(2020\)](#) to assess endogeneity using the Gaussian Copula (GC) approach. The GC method is preferred as it directly accounts for the correlation between the potentially endogenous regressor and the error term without needing additional variables ([Becker et al., 2022](#); [Park and Gupta, 2012](#)). It overcomes the limitations of traditional methods like instrumental variables (IVs) for handling endogeneity effectively. We tested if variables exhibiting endogeneity are non-normally distributed using the Kolmogorov-Smirnov test on scores for task codification, managing task complexity, and supplier capability. None of the constructs exhibited normally distributed scores, making [Park and Gupta's \(2012\)](#) GC method ideal for our research ([Eckert & Hohberger, 2023](#)). We created models with various Gaussian copulas tested via bootstrapping. [Table 6](#) shows no significant findings (p -value > 0.05), indicating no endogeneity issue. We also assessed potential multicollinearity using variance inflation factors (VIFs). VIF values from 1.098 to 1.486 suggest no multicollinearity issues, as they are below the threshold of 5 ([Hair et al., 2017](#)). Thus, multicollinearity is not a concern in our model.

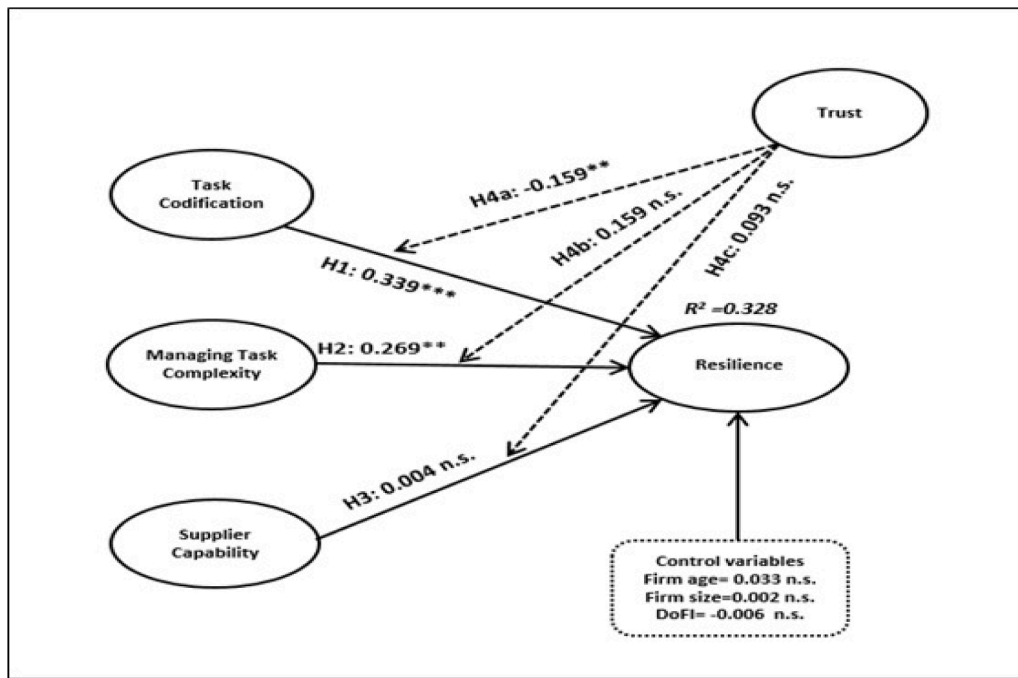


Fig. 2. Assessment of the structural model. Notes: *** $p < 0.001$; ** $p < 0.05$; * $p < 0.10$; n.s., not significant.

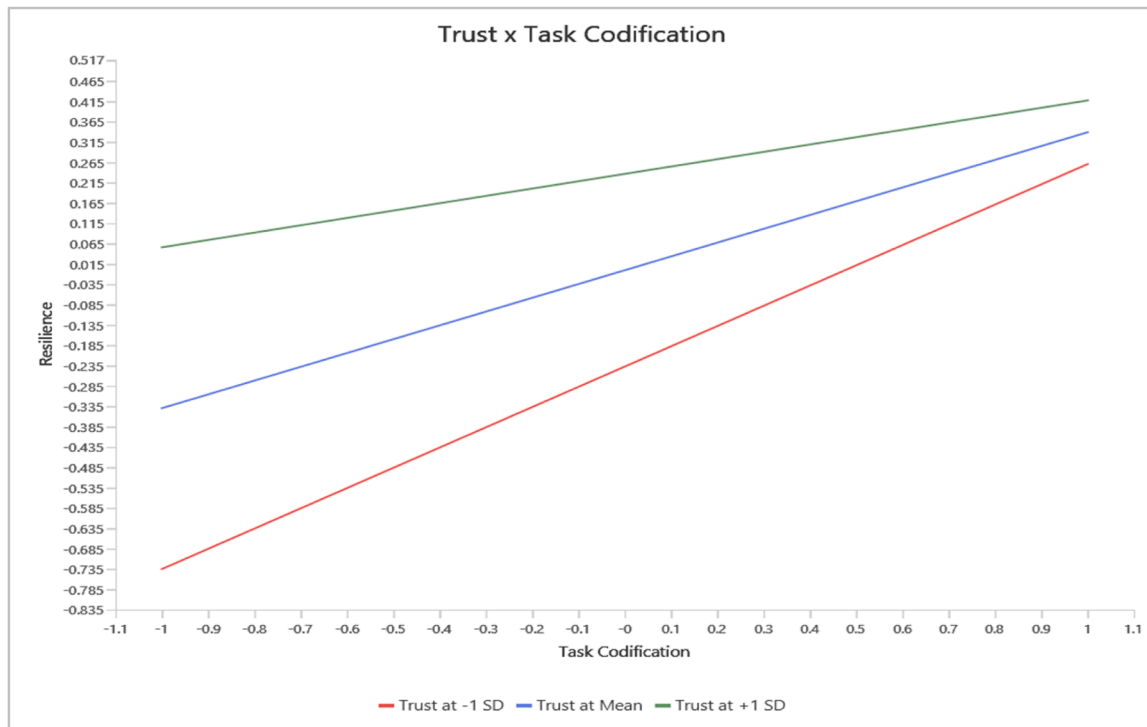


Fig. 3. Simple slopes graph for the interaction effect of trust and task codification on resilience.

6. Discussion and implications

This study contributes to the GVC governance and resilience literature showing that external governance mechanisms—task codification and managing task complexity - are not just structural attributes but dynamic governance adaptations that balance governance efficiency and requirements (TCE) with continuous changes and learning (DCV) to enhance supplier resilience, particularly in politically unstable environments. Additionally, it challenges the conventional assumption that

trust uniformly benefits buyer-supplier linkages in GVCs by revealing its dark side via negative moderation between task codification and resilience, showing that while trust facilitates collaboration, excessive reliance without governance safeguards can increase vulnerabilities, making governance mechanisms more critical for resilience in volatile contexts.

The finding that supplier capability did not significantly impact resilience, especially in politically unstable regions, warrants further discussion. While previous research emphasizes the role of capabilities

Table 6

Assessment of endogeneity using the Gaussian copula approach.

GC Model	Construct	Coefficient	P value	GC Model	Construct	Coefficient	P value
Gaussian copula of model 1 (endogenous variable; TC)	TC	0.423	0.450	Gaussian copula of model 5 (endogenous variables; TC, MCX)	TC	0.419	0.463
	MCX	0.256	0.007		TCX	0.239	0.248
	SC	0.070	0.365		SC	0.076	0.400
	*TC	−0.046	0.934		*TC	−0.043	0.940
Gaussian copula of model 2 (endogenous variable; MCX)	TC	0.376	0.000	Gaussian copula of model 6 (endogenous variables; MCX, SC)	*MCX	0.016	0.914
	MCX	0.238	0.242		TC	0.369	0.000
	SC	0.077	0.400		TCX	0.242	0.226
	*MCX	0.016	0.910		SC	−0.331	0.226
Gaussian copula of model 3 (endogenous variable; SC)	TC	0.369	0.000	Gaussian copula of model 7 (endogenous variables; TC, MCX, SC)	*MCX	0.006	0.969
	MCX	0.248	0.008		*SC	0.398	0.144
	SC	−0.330	0.221		TC	0.495	0.374
	*SC	0.398	0.138		TCX	0.244	0.229
Gaussian copula of model 4 (endogenous variables; TC, SC)	TC	0.496	0.365	Notes: * indicates the copula term in the model. TC= task codification, MCX= managing task complexity, SC= supplier capability.	SC	−0.336	0.219
	MCX	0.248	0.008		*TC	0.004	0.980
	SC	−0.336	0.213		*MCX	0.403	0.142
	*TC	0.403	0.136		*SC	−0.128	0.819
	*SC	−0.129	0.815				

in facilitating upgrading and competitiveness (Bustinza et al., 2019; Gereffi et al., 2022), our findings suggest that capabilities such as technological expertise and product development alone are insufficient for ensuring resilience in politically volatile environments.

Interestingly, the lack of a moderation effect between managing task complexity and resilience suggests that the direct impact of managing task complexity on resilience may overshadow the influence of trust. Managing complex tasks necessitates robust governance and operational systems critical for resilience, regardless of the level of trust between partners. This finding suggests that while trust can influence some governance relationships, its impact may be less pronounced in the context of highly complex tasks. In doing so, we extend the DCV by emphasizing that resilience in the face of complex tasks is less about the interpersonal trust between partners and more about the capacity of firms to manage operational complexities and adapt effectively (Teece, 2007).

6.1. Theoretical contributions

This study contributes to the GVC governance and resilience literature in several important ways. First, we comprehensively examine specific governance mechanisms—task codification, managing task complexity, and supplier capability—and their differential effects on supplier resilience in GVCs (cf. Gereffi et al., 2005; Islam & Chadee, 2024). While previous research has predominantly focused on the role of static GVC governance in enhancing or hindering supplier upgrading (Lee & Gereffi, 2021), our study moves beyond the upgrading-governance nexus to investigate adaptive governance mechanisms that directly contribute to supplier resilience amid political instability. This insight builds on recent advances in the IB literature (Islam and Chadee, 2024; Kano et al., 2022), which challenge the static assumptions of the Gereffi et al. (2005) typology—where codification, complexity, and capability are treated as structural inputs determining five ideal governance types (market, modular, relational, captive, and hierarchy). Our findings align with this emerging perspective and extend it by showing that individual governance mechanisms (e.g., codification, complexity management) are not exclusive to one governance type, but function as dynamic tools that firms combine and reconfigure in response to external shocks. The significant relationships found between managing task complexity and resilience (Choksy et al., 2017) and task codification and resilience (Sturgeon, 2002) highlight the context-specific nature of governance in politically unstable regions.

In such environments, governance mechanisms need to adapt to the unique challenges suppliers face (cf. Kano et al., 2022).

Our findings show that a combination of hands-off mechanisms, such as task codification, and hands-on mechanisms, such as management of task complexity, is more effective in supporting resilience in these contexts (e.g., Bustinza et al., 2019; Choksy et al., 2022; Sinkovics et al., 2019). Our work adds to the literature by demonstrating that task codification and managing task complexity are more than simply drivers of governance types. These findings illustrate that both codification and managing task complexity simultaneously embody principles of efficiency and adaptability: they formalize coordination to reduce ambiguity and transaction risk (TCE), while also enabling flexible, learning-oriented responses to disruption (DCV). Rather than aligning singularly with either theory, these governance mechanisms reflect an integrated logic—balancing stability with adaptability to support supplier resilience under institutional volatility. This insight aligns with Kano et al. (2022), who emphasize that managerial governance mechanisms (e.g., supplier coordination, digital investments, stakeholder engagement) play a critical role in GVC resilience, beyond structural changes such as reshoring or vertical integration. Thus, codification and managing task complexity are not only structural drivers of governance modes but also dynamic governance mechanisms that integrate TCE-driven efficiency with DCV-driven adaptability.

Second, our study challenges the long-standing assumption in GVC research that supplier capability is the primary driver of upgrading and performance (Choksy et al., 2017; Gereffi et al., 2005). According to this view, supplier capability facilitates functional upgrading, which, in turn, helps suppliers capture higher profits in GVCs. However, these assumptions become questionable when considering the instability of the political environment. Recent research suggests that institutional instability significantly impacts governance mechanisms (Islam and Chadee, 2024; Sinkovics et al., 2019). Accordingly, our study discovered that external governance mechanisms, namely task codification and managing task complexity, are more crucial in fostering resilience than supplier capability alone in politically unstable locations. This reinforces our theoretical framework that resilience is not driven solely by internal capabilities but by how firms engage with governance mechanisms that integrate transactional safeguards (TCE) with adaptive problem-solving and coordination (DCV) under adverse conditions. Our contribution aligns with and extends recent IB work on GVC resilience (e.g., Islam & Chadee, 2024; Kano et al., 2022). Our analysis adds to this discussion by incorporating political instability as a boundary condition, revealing

that the relative value of governance mechanisms varies according to institutional uncertainty. Furthermore, we extend the supplier agency perspective (Choksy et al., 2017; Choksy et al., 2022) by demonstrating that under instability, suppliers exercise their agency in adapting to task codification and managing task complexity to build resilience.

Finally, we highlight the contingency role of trust in shaping GVC supplier resilience. While trust is traditionally viewed as a facilitator of positive business relationships, our study extends this view by exploring the “dark side” of trust, which may have negative implications for GVCs’ resilience (Sinkovics et al., 2021). Specifically, we find that trust negatively moderates the relationship between codification and resilience, revealing that in high-risk environments, over-reliance on trust can displace necessary formal safeguards. Building on emerging critiques (Sinkovics et al., 2021; Villena et al., 2011), our findings support the view that excessive trust can suppress governance formalization, reduce vigilance, and ultimately undermine supplier resilience. This insight is vital in understanding trust dynamics in GVCs, offering a more dynamic view that highlights trust’s dual role in supporting collaboration and introducing risk. This calls into question the prevailing premise in the GVC governance framework by Gereffi et al. (2005), which holds that trust uniformly enhances supplier relationships and lowers transaction costs. Crucially, this finding challenges the long-standing assumption that trust strengthens relational governance, which in turn is beneficial for supplier upgrading. Our study indicates that trust may erode coordination effectiveness by discouraging codification and structured oversight, thus exposing suppliers to greater risk. Therefore, instead of viewing relational governance as an ideal condition for suppliers, our study supports a more critical, context-sensitive interpretation that in volatile contexts, over-reliance on trust might harm governance enforcement, making firms more vulnerable to external shocks.

This finding invites a deeper theoretical integration of our results with the logics of TCE and DCV. From a TCE perspective, trust is typically seen as a substitute for formal governance, reducing opportunism and lowering coordination costs. From a DCV standpoint, trust enhances adaptability by fostering informal knowledge flows, joint problem-solving, and relational learning. Yet, our findings reveal that in politically unstable GVCs, excessive trust may reduce the use of codification, weakening both the transactional safeguards emphasized by TCE and the dynamic alignment processes encouraged by DCV. This highlights a theoretical tension: while trust is often positioned as a facilitator of governance, it may become counterproductive when it displaces formal mechanisms that are essential for resilience in volatile environments.

6.2. Managerial implications

Our findings have important implications for managers responsible for configuring and managing GVCs in politically unstable regions. First, managers should strengthen task codification to allow international clients to specify detailed requirements and give feedback during project initiation. In unstable regions, codification enhances supplier resilience by providing clarity amidst volatility. However, governance strategies must be adaptable to the supplier’s context, combining hands-on mechanisms for managing task complexity with hands-off codified processes that allow suppliers to navigate disruptions effectively. Vendor managers must develop a nuanced, context-sensitive governance approach, ensuring that codification does not become overly rigid but remains flexible enough to accommodate rapid changes and evolving project demands.

Second, while trust is important for supporting collaboration, vendor management managers and IT project managers should be cautious about over-reliance on trust, particularly in politically unstable environments. Trust can diminish the need for vigilance and proactive risk management. Managerial structures that favor informal communication over documentation, or relational governance forms that lack escalation mechanisms, may further exacerbate the vulnerability of suppliers. Vendor management managers should strike a balance by maintaining

open communication, regularly reviewing contingency plans, and encouraging risk management practices, regardless of the level of trust in the relationship. Furthermore, IT project managers should evaluate different types of trust—competence versus goodwill trust—and adapt governance strategies accordingly to balance collaboration with robust risk management. This balanced approach will enable firms to leverage trust where beneficial while reinforcing formal governance mechanisms that ensure supplier stability amid external disruptions.

6.3. Limitations and future research

Despite its contributions, this study has several limitations that offer important directions for future research. First, the study relies on cross-sectional data collected at a single point in time, complicating the determination of causality between the key variables (e.g., governance, resilience, and trust). Moreover, this research design is prone to CMV since all data were gathered from a single source. These limitations may affect the interpretation of the non-significant findings, such as the absence of a significant relationship between supplier capability and supplier resilience. Future research could address these concerns by employing longitudinal designs or multi-source data collection, allowing for a more thorough assessment of the relationships over time.

The sample is limited to suppliers in politically unstable regions, which affects the generalizability of the findings. While this focus yields insights into GVCs facing external risks, it may not apply to suppliers in politically stable areas. In stable environments, supplier resilience might depend more on operational efficiency and supply chain optimization than on crisis management. Future research could explore these dynamics across regions with varying political stability, providing a clearer understanding of how external factors shape governance, resilience, and trust. Comparative studies of stable versus unstable regions would enhance the findings’ generalizability.

Third, the timing of data collection during the COVID-19 pandemic presents another limitation. The pandemic significantly disrupted global supply chains, likely amplifying the effects of managing task complexity and task codification on resilience. The heightened global uncertainty and challenges to supply chain operations during this period may have strengthened the observed relationships between these variables. Future research could replicate the study in post-pandemic contexts or across different time periods to evaluate the findings under varying environmental conditions.

This study focuses on the software industry; however, future research should examine other sectors to determine how governance and resilience strategies differ. In industries like automotive, where supply chain disruptions have direct impacts, hands-on governance may be more crucial than in the software sector, which relies heavily on knowledge and digital infrastructure. Additionally, industries like pharmaceuticals may emphasize regulatory compliance and safety in their governance. Investigating these differences can provide valuable insights into how industry-specific traits shape governance, resilience strategies, and supplier management in GVCs (cf. Kano et al., 2022).

Fifth, the potential negative moderating role of trust suggests that future studies should examine how different types of trust, such as competence versus goodwill trust, impact resilience in GVCs. Investigating these differential effects could clarify when and how trust supports or undermines resilience, particularly in politically unstable regions.

Sixth, a promising area for future research involves using fuzzy-set Qualitative Comparative Analysis (fsQCA) to better capture the nuanced trade-offs among codification, complexity, and supplier capability in shaping supplier resilience. Unlike traditional regression-based methods, fsQCA explores causal asymmetry and configurational relationships (Ragin, 2009), making it ideal for analyzing the interplay of governance variables that collectively influence resilience. For instance, fsQCA could identify distinct combinations of high codification, moderate complexity, and strong supplier capability that promote resilience

in politically unstable regions, while also highlighting configurations that impede it. This method allows for the examination of how governance variables function as interdependent elements within specific contexts, providing insights into how different combinations of trade-offs achieve resilience amid varying environmental uncertainties. Such an approach would enhance theoretical understanding while offering practical insights for tailoring governance strategies in GVCs.

Seventh, given the escalating role of digital technologies in transforming GVCs (cf. Butollo et al., 2022; Strange & Zucchella, 2017), it is crucial to explore how emerging technologies, such as blockchain, AI, and the Internet of Things (IoT), affect governance, resilience, and trust within GVCs (Dilyard et al., 2021; Ghauri et al., 2021). These technologies can enhance transparency, streamline supply chain operations, and reduce reliance on traditional trust-building mechanisms. Therefore, understanding how these technologies interact with governance mechanisms, especially in politically unstable regions, could yield comprehensive insights into how digital globalization reshapes the dynamics of resilience and governance within GVCs.

Finally, in this study, we did not account for the project-related differences (game app versus health-related app) in the software

development value chain. Future research should explore how trust operates differently across project types (e.g., standardized vs. custom software), governance forms (e.g., captive vs. modular), and organizational routines (e.g., feedback frequency, client rotation) to uncover when and how trust enhances or undermines resilience.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the lead author used GPT - 4 in order to improve the readability of the manuscript. After using this tool, the lead author reviewed and edited the content as needed and takes full responsibility for the content of the publication.

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Appendix

Table A1
Operationalisation of constructs

Construct	Item	Relevant Insights from Academic Papers	Relevant Survey Items from Papers	Relevant Interview Quotes
Task Codification	Our major international clients are able to specify detailed software requirements during the initial phase of the project.	Explicit documentation of software requirements is critical in global value chains to facilitate smooth knowledge transfer between clients and suppliers (Sinkovics et al., 2019). Client documentation practices influence vendors' ability to integrate solution and need knowledge in global software projects (Choksy et al., 2024).	The firm's main customers are able to specify product and process characteristics (Ozatagan, 2011). The firm's main customers are able to impose quality and technical standards (Ozatagan, 2011).	"A typical project begins with the project manager engaging in discussing requirements with the client. We identify the objectives of the project, the budget, and time constraints, and invest the effort to understand the client's vision about the software solution they are aiming to build." "When we were working with Japanese clients, we were required to submit documented processes. It included how we are going to analyze the requirements, how we are going to execute the project, and the documents that we roll out in the planning phase." "Once the requirements and GUI design are signed off by the client, the stage is set for detailed database and application design. Effort goes into ensuring that the database design is logical, not overly complex, and flexible to handle future requirements." Clients provide final, documented requirements for software projects to ensure clarity in execution.
Task Codification	Our major international clients are able to clearly specify user expectations.	Clearly defined user expectations help in bridging the gap between business domain knowledge and technical execution (Sinkovics et al., 2019). User needs must be captured systematically through formal requirement specifications and knowledge transformation (Choksy et al., 2024).		"In some cases, some customers actually write details of how they want the software to be made. They are involved in deciding the goals they want, they give a bigger list of features, you negotiate on what can be done, and then you detail it out." "Our clients expect software to have great user experience. They want demos every other week and progress updates. They provide feedback on things like colors, layouts, and user interactions." "Two Dutch clients will have different requirements. Unless we make something for them, we do not know what they want. At the project proposal level, everything seems good, but actual development reveals their true expectations." Explicit articulation of user expectations

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Table A1 (continued)

Construct	Item	Relevant Insights from Academic Papers	Relevant Survey Items from Papers	Relevant Interview Quotes
Task Codification	Our major international clients provide documented feedback related to business domains, beyond mere technicalities.	Feedback mechanisms must be formally structured to ensure that knowledge connectivity supports software development processes (Sinkovics et al., 2019). Feedback mechanisms are critical in enabling knowledge transformation and must be well-documented for effective learning (Choksy et al., 2024).	The feedback from testers provided concrete suggestions of game-level settings, story-line, music, and animation features (Liu et al., 2019)	helps in aligning software features with business needs. "Now we are at a level that everything we do, we do minutes of each and every meeting. Even if clients do not do it or demand it, we develop minutes of meetings and send it out to them saying, 'this is what we understood'. "One of the biggest clients was very formal about feedback. He wanted minutes of meetings, updated project plans every Tuesday, and markups before conversations took place. He wanted everything documented." "The client was required to codify HTML and embed specific tags in the web apps to ensure mobile compatibility. We followed this process as per client documentation." "By standards, we mean defining product features. The main learning was to acquire knowledge through working with standards, especially technical standards. Each file version is stored in records so that changes over time can be tracked." "The customer spent a lot of time with our team, iterating on requirements, markups, and demos. He was involved in weekly progress updates, ensuring structured tracking of requirement changes." "For Japanese clients, we documented each change, rolling out revised requirements at every phase. This ensured structured implementation of evolving requirements." "Understanding the customer's business and having the knowledge base to differentiate yourself is the key to growth." "Tell me about one project when an international client's expertise or training was crucial for project success. That was the first project. The product training was completely provided by him." "If someone comes to me with a real estate project, I am totally dependent on that customer to give me training to transfer domain knowledge. The customer is generally the domain expert." "The client is tightly involved, and we coordinate with them on a daily basis." "How we normally set up our project is that we give the customer access to Basecamp. They can post ideas, ask questions, and track feedback. This platform helps offshore teams clarify requirements." "We document requirement discussions with Japanese clients to ensure clarity and consistency. Each phase is documented to prevent miscommunication." Continuous refinement of software requirements through frequent coordination improves project outcomes "Requirements are never defined right. When you're working in a start-up and you're working at high velocity, requirements are driven by customers. We follow two-week or three-week sprints." "There was this project where the client was meeting every day, 3–4 hours of meeting daily. Very high involvement and requirement changes were continuous." "Customers are deeply engaged with our team via video conferences, daily updates, and weekly releases. They receive weekly builds and provide immediate feedback."
Task Codification	Our major international clients clearly codify any changes in software requirements.	Codified requirement changes ensure that global suppliers can systematically update and align software functionality with business needs (Sinkovics et al., 2019). Clear codification of requirement changes facilitates absorptive capacity development, ensuring traceable updates in software projects (Choksy et al., 2024).	The feedback from testers provided detailed information about each identified bug or glitch (Liu et al., 2019)	
Managing Task Complexity	We coordinate frequently with international clients to deal with specialized knowledge required for software development tasks.	Tacit knowledge transfer is essential for software development in global value chains. Coordination mechanisms are necessary to align specialized knowledge with project needs (Sinkovics et al., 2019). Vendors must integrate multiple external knowledge sources and agile engagement mechanisms to navigate complexity (Choksy et al., 2024).	The team used a structured sprint planning process to manage task complexity effectively. The project involved multiple software environments (Xia & Lee, 2005). The project involved multiple technology platforms (Xia & Lee, 2005). The project involved a lot of integration with other Systems (Xia & Lee, 2005). Testers provided detailed and concrete feedback, enabling refinement of project requirements (Liu et al., 2019).	
Managing Task Complexity	We coordinate frequently with our major international clients to understand and clarify the initial software requirements.	Software activities are highly coupled, requiring continuous refinement between production and design phases (Sinkovics et al., 2019). Client involvement facilitates the transfer of domain and user knowledge, requiring extensive interaction (Choksy et al., 2024).		
Managing Task Complexity	We coordinate frequently with our major international clients to cope with changing requirements during the latter phases of the project.	Continuous two-way interactions between clients and suppliers are critical for adapting to requirement changes (Sinkovics et al., 2019). Agile engagement helps vendors dynamically cope with changing requirements through iterative cycles (Choksy et al., 2024).	The development team iteratively adjusted work based on continuous client feedback loops. The Development Team iteratively receives improvement suggestions from game testers (Liu et al., 2019) The Development Team iteratively receives comments from game testers at different development stages (Liu et al., 2019) The Development Team receives feedback from game testers on	

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Table A1 (continued)

Construct	Item	Relevant Insights from Academic Papers	Relevant Survey Items from Papers	Relevant Interview Quotes
Supplier Capability	Engagement in the development of new product ideas with major international clients.	<ul style="list-style-type: none"> Offshore service providers overcome country risks by initiating and maintaining knowledge connectivity with international clients (Sinkovics et al., 2019). Vendors in peripheral regions acquire “need knowledge” from clients to co-develop products (Choksy et al., 2024). 	<p>player’s preference at all times (Liu et al., 2019).</p> <p>The end-users’ information needs changed rapidly (Xia & Lee, 2005).</p> <p>IT architecture that the project depended on changed rapidly (Xia & Lee, 2005).</p> <p>IT infrastructure that the project depended on changed rapidly (Xia & Lee, 2005).</p> <p>Software development tools that the project depended on changed rapidly (Xia & Lee, 2005).</p> <p>Design & Product Development Capabilities (Ozatagan, 2011)</p>	<p>- "If they want us to be their offshore house we are capable of building the whole software from design to development..."</p> <p>- "The learning comes from the new requirement, new challenge that we face of developing..."</p> <p>- "We have extensive experience in the software industry enabling us to offer solutions to our clients which others don't even think are possible."</p>
Supplier Capability	Engagement in product definition with major international clients.	<ul style="list-style-type: none"> Vendors work closely with clients through iterative requirement analysis and agile engagement (Choksy et al., 2024). Frequent communication ensures product specifications are aligned with market needs (Sinkovics et al., 2019). 	Design & Product Development Capabilities (Ozatagan, 2011)	
Supplier Capability	Engagement in the analysis of product needs with major international clients.	<ul style="list-style-type: none"> Peripheral vendors build absorptive capacity by interacting with global clients to refine product needs (Choksy et al., 2024). 	Analysis of Market & Client Needs (Ozatagan, 2011)	
Supplier Capability	Engagement in complex software engineering tasks necessary to transform design specifications into the actual software product.	<ul style="list-style-type: none"> Peripheral vendors integrate technical expertise with international requirements, ensuring precise implementation (Choksy et al., 2024). Pakistani IT firms develop software engineering solutions, overcoming institutional challenges (Sinkovics et al., 2019). 	Integration of Technical Capabilities into Production (Ozatagan, 2011)	

Data Availability

Data will be made available on request.

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