INTERNATIONAL JOURNAL OF COMMERCE AND MANAGEMENT RESEARCH STUDIES (IJCMRS)
(Open Access, Double-Blind Peer Reviewed Journal)
ISSN Online: 3049-1908 ISSN Print:
EDU SCHOOL
ijcmrs.com

Supply Chain Finance Adoption, Working Capital Efficiency, and Firm Profitability Among Manufacturing SMEs: Panel Evidence from Southeast Asia

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Article information

Received:13th December 2025
Received in revised form:15th January 2026
Accepted:17th February 2026
Available online: 26th March 2026

Volume:3
Issue: 1
DOI: https://doi.org/10.5281/zenodo.19252901

Abstract

Supply chain finance (SCF) represents a rapidly expanding set of financial instruments and platforms designed to optimize liquidity distribution across buyer-supplier networks by leveraging anchor buyer creditworthiness to extend affordable financing to supply chain participants. Despite its growing commercial prominence and its theoretical promise as a solution to working capital constraints facing manufacturing small and medium enterprises (SMEs) in developing economies, rigorous empirical evidence on the firm-level performance outcomes of SCF adoption among SMEs remains limited. This study employs a balanced panel dataset of 341 manufacturing SMEs across Thailand, Indonesia, and the Philippines over eight fiscal years from 2016 to 2023 to examine the relationship between SCF adoption, cash conversion cycle efficiency, and return on assets. Two-way fixed effects panel regression, augmented by instrumental variable estimation and dynamic GMM to address endogeneity and persistence in working capital outcomes, constitutes the primary analytical method. Results indicate that SCF adoption is associated with a statistically significant reduction in the cash conversion cycle of 18.4 days ($p < 0.001$) and an improvement in return on assets of 2.3 percentage points ($p < 0.01$). Buyer relationship quality, SCF platform digital maturity, and anchor buyer credit rating positively moderate the performance effects of SCF adoption. Qualitative evidence from 28 semi-structured interviews with SCF program managers and SME finance directors illuminates the operational mechanisms through which these gains are realized and identifies persistent barriers including collateral-free financing skepticism and platform interoperability limitations. The study contributes to the supply chain finance, working capital management, and SME finance literatures and offers actionable recommendations for banks, fintech SCF providers, and trade finance policymakers in the ASEAN region.

Keywords: - Supply Chain Finance, Working Capital Management, Cash Conversion Cycle, Manufacturing Smes, Southeast Asia, Dynamic Panel GMM, Buyer-Supplier Relationships, Fintech

I. INTRODUCTION

Working capital management occupies a central position in the financial management of manufacturing enterprises, as the efficiency with which firms manage their inventory, receivables, and payables determines their capacity to sustain operations, invest in growth, and withstand liquidity shocks (Deloof, 2003). For small and medium enterprises in manufacturing-intensive emerging economies, the working capital challenge is particularly acute. Manufacturing SMEs typically operate with thin margins, capital-intensive production processes, and asymmetric bargaining positions vis-a-vis larger anchor buyers, which frequently impose extended payment terms that stretch supplier liquidity and generate persistent financing gaps (Hofmann & Belin, 2011). The International Finance Corporation estimated the SME financing gap in emerging markets at USD 5.2 trillion annually, with working capital constraints constituting the single most frequently cited barrier to operational stability and growth investment (IFC, 2020).

Supply chain finance has emerged as a commercially and analytically significant response to this structural challenge. Unlike traditional lending, which evaluates borrower creditworthiness in isolation, SCF instruments leverage the

creditworthiness of large anchor buyers to extend more affordable and accessible financing to their suppliers through mechanisms including reverse factoring, dynamic discounting, inventory financing, and purchase order financing (Hofmann & Belin, 2011). By redistributing liquidity from capital-abundant buyers to capital-constrained suppliers, SCF programs theoretically improve working capital efficiency across the supply chain without requiring increased bank credit limits or additional collateral from SME borrowers.

The Association of Southeast Asian Nations (ASEAN) region represents a particularly consequential context for SCF development. Manufacturing SMEs constitute between 88 and 97 percent of all enterprises in ASEAN member states, collectively contributing approximately 42 percent of regional GDP and employing over 70 percent of the private sector workforce (ASEAN, 2020). The region's deep integration into global manufacturing value chains through electronics, automotive, food processing, and textiles sectors creates both a high demand for working capital financing and a structural environment in which anchor buyer creditworthiness can serve as the foundation for SCF program design. Thailand, Indonesia, and the Philippines, three of ASEAN's five largest economies, share these structural characteristics while exhibiting sufficient institutional diversity to enable meaningful cross-country comparison.

Despite SCF's growing commercial footprint, the academic literature has not kept pace with practitioner interest. Most published studies are conceptual or case-based, documenting implementation frameworks and pilot program experiences rather than estimating performance effects with appropriate controls and identification strategies (Gelsomino et al., 2016). The few quantitative studies available focus on large listed corporations rather than SMEs, and evidence from Southeast Asia is virtually absent. Critically, the endogeneity problem inherent in SCF adoption research, the possibility that better-performing firms self-select into SCF programs rather than SCF generating performance improvements, has rarely been addressed through appropriate econometric methods.

This study addresses these gaps through three research questions: (1) Does SCF adoption significantly improve cash conversion cycle efficiency and return on assets among manufacturing SMEs in Thailand, Indonesia, and the Philippines? (2) What firm-level and program-level factors moderate the performance effects of SCF adoption? (3) Through what operational mechanisms do SCF-adopting SMEs realize working capital and profitability improvements?

The paper proceeds as follows. Section 2 reviews the theoretical foundations and empirical literature on working capital management and SCF. Section 3 describes the research design, data, and analytical methods. Section 4 presents the empirical results. Section 5 discusses the findings and their implications. Section 6 concludes with recommendations and limitations.

II. LITERATURE REVIEW

2.1. Working Capital Management and Firm Performance

The relationship between working capital management efficiency and firm performance has been extensively studied since the seminal contributions of Gitman (1974), who introduced the cash conversion cycle (CCC) as a comprehensive metric for working capital efficiency. The CCC measures the net days elapsed between cash outflows for inventory procurement and cash inflows from customer collections, capturing the duration for which a firm must finance its operating cycle from internal or external sources. A shorter CCC implies lower financing costs, reduced liquidity risk, and greater operational flexibility. Shin and Soenen (1998) provided early empirical evidence that CCC was negatively correlated with firm profitability in a large US sample, a finding replicated by Deloof (2003) using Belgian data and extended to emerging markets by Padachi (2006) in Mauritius and Garcia-Teruel and Martinez-Solano (2007) in Spain.

The theoretical channels through which working capital efficiency affects profitability are well established. First, shorter receivables collection periods reduce the opportunity cost of tied-up capital and the credit risk of customer default (Richards & Laughlin, 1980). Second, leaner inventory positions reduce warehousing costs, obsolescence risk, and the financing cost of inventory investment, though Blinder and Maccini (1991) identified a just-in-time tradeoff whereby excessive inventory reduction exposes firms to stockout costs. Third, extended accounts payable terms provide cost-free short-term financing from suppliers, though Ng et al. (1999) demonstrated that early payment discount capture generates positive net present value when the discount rate exceeds the firm's cost of capital. The optimal working capital position balances these competing considerations and is firm and industry-specific.

2.2. Supply Chain Finance: Instruments, Mechanisms, and Theoretical Foundations

Supply chain finance has been defined by the Global Supply Chain Finance Forum (2016) as the use of financing and risk mitigation practices and techniques to optimize the management of the working capital and liquidity tied up in supply chain processes for collaborating business partners. The theoretical foundations of SCF draw from transaction cost economics (Williamson, 1985), relational contracting theory (Macneil, 1980), and financial intermediation theory (Diamond, 1984). Transaction cost economics frames SCF as a governance innovation that reduces the search, negotiation, and enforcement costs associated with bilateral supplier financing arrangements by embedding financing within established buyer-supplier relationships. Relational contracting theory highlights the role of trust and repeated interaction in enabling the risk-sharing arrangements that underpin SCF program design.

Reverse factoring, the most commercially prevalent SCF instrument, involves a financial intermediary offering to purchase confirmed supplier invoices at a discount reflecting the anchor buyer's credit rating rather than the supplier's own creditworthiness, and collecting payment from the buyer at the original invoice maturity date (Klapper, 2006). For SME suppliers, the financial benefit is the spread between their own financing cost, which may range from 8 to 25 percent per annum in emerging market contexts, and the anchor buyer-priced reverse factoring rate, which may be 3 to 6 percent per annum for investment-grade buyers. Hofmann and Belin (2011) documented that this spread generates substantial working capital cost savings for participating suppliers, while enabling buyers to preserve or extend payment terms without deteriorating supplier financial health.

2.3. Empirical Evidence on SCF Performance Outcomes

The empirical literature on SCF performance outcomes is growing but remains methodologically uneven. Wuttke et al. (2013) conducted a qualitative multi-case study of SCF adoption among European manufacturers and identified liquidity improvement, relationship strengthening, and supply chain risk reduction as the primary perceived benefits, while noting that quantification of benefits was rarely undertaken systematically by adopting firms. Liebl et al. (2016) analyzed survey data from 207 German firms and found that SCF program participation was associated with significantly lower working capital ratios, though the cross-sectional design precluded causal inference.

More recent quantitative contributions have made progress on identification. Caniato et al. (2019) analyzed a proprietary dataset of reverse factoring programs administered by a major European bank and documented statistically significant reductions in supplier CCC of approximately 15 days on average, though the sample was confined to large European corporations. Silvestri et al. (2021) provided event study evidence that SCF program announcements were associated with positive cumulative abnormal returns for announcing firms, suggesting that financial markets interpret SCF adoption as value-creating. Neither study examined SME-specific outcomes, and no study to date has employed dynamic panel methods to address the persistence of working capital outcomes and the endogeneity of adoption decisions in an emerging market manufacturing context.

2.4. Moderating Factors in SCF Effectiveness

The SCF literature has increasingly recognized that program performance is heterogeneous across firms and program designs. Buyer relationship quality has been identified as a critical moderator: suppliers with longer-tenured, higher-volume buyer relationships have access to confirmed invoice programs with lower discounting rates and fewer documentation requirements, amplifying the working capital benefit of SCF participation (Kouvelis & Zhao, 2012). Anchor buyer credit rating directly determines the reverse factoring pricing advantage available to suppliers, creating a stratified distribution of SCF benefits in which suppliers of investment-grade buyers gain more than those of sub-investment-grade buyers.

Digital platform maturity has emerged as an increasingly important determinant of SCF program efficiency as fintech-enabled SCF platforms have entered competition with bank-administered programs. Platforms offering automated invoice matching, real-time confirmation, and straight-through processing eliminate the manual verification delays that historically limited SCF scalability for smaller transaction volumes. Camerinelli (2009) argued that platform digitization was the enabling condition for SCF's extension from large corporates to the SME segment, and subsequent practitioner evidence from platforms including Taulia, C2FO, and Orbian has supported this proposition, though academic validation using enterprise-level outcome data is limited.

2.5. Research Gaps

Four gaps in the existing literature directly motivate the present study. First, quantitative evidence on SCF performance outcomes specifically among manufacturing SMEs, rather than large corporations, is absent. Second, the endogeneity of SCF adoption, arising from the possibility that financially healthier SMEs are more likely to be invited into anchor buyer SCF programs, has not been addressed through appropriate instrumental variable or dynamic panel methods in any published study. Third, Southeast Asia as a regional context for SCF research has been entirely neglected despite the region's significance as a global manufacturing hub. Fourth, the mechanisms linking SCF adoption to working capital improvements, mediated by buyer relationship quality and platform digital maturity, have not been tested within a unified quantitative and qualitative framework.

III. RESEARCH METHODOLOGY

3.1. Research Design

This study employs a mixed-methods longitudinal research design. The quantitative strand uses a balanced panel of manufacturing SMEs observed across eight consecutive fiscal years, enabling the application of firm and year fixed effects to control for time-invariant heterogeneity and macroeconomic confounders. The dynamic panel generalized method of moments (GMM) estimator is employed as the primary identification strategy to address the dual challenges of working capital persistence and endogenous SCF adoption. The qualitative strand collects semi-structured interview data from SCF program managers at anchor buyers and financial institutions, and from finance directors at adopting SMEs, to illuminate the operational mechanisms, relational dynamics, and institutional barriers that quantitative data cannot directly capture. The mixed-methods integration follows a sequential explanatory design in which quantitative findings guide qualitative inquiry (Creswell and Plano Clark, 2018).

3.2. Research Objectives

The following specific objectives guided the study:

- Objective 1: To estimate the effect of SCF adoption on the cash conversion cycle of manufacturing SMEs in Thailand, Indonesia, and the Philippines using two-way fixed effects and dynamic GMM panel methods.
- Objective 2: To examine the effect of SCF adoption on return on assets, controlling for firm size, leverage, sales growth, and macroeconomic conditions.
- Objective 3: To test the moderating roles of buyer relationship quality, anchor buyer credit rating, and SCF platform digital maturity on the SCF-performance relationship.
- Objective 4: To explore qualitatively the operational mechanisms through which SCF adoption generates working capital improvements and the barriers that limit realization of program benefits.

3.3. Hypotheses

The following hypotheses were formulated on the basis of the theoretical framework and literature review:

- H1: SCF adoption is negatively associated with the cash conversion cycle among manufacturing SMEs.
- H2: SCF adoption is positively associated with return on assets among manufacturing SMEs.
- H3: Buyer relationship quality positively moderates the effect of SCF adoption on cash conversion cycle reduction.
- H4: Anchor buyer credit rating positively moderates the effect of SCF adoption on both cash conversion cycle and return on assets.
- H5: SCF platform digital maturity positively moderates the effect of SCF adoption on cash conversion cycle reduction.
- H6: The positive effect of SCF adoption on return on assets is mediated by cash conversion cycle efficiency.

3.4. Sample and Data

The target population comprised manufacturing SMEs with annual revenues between USD 500,000 and USD 50 million, at least five employees, and at least one verifiable buyer-supplier relationship with an anchor firm operating an SCF program. Three countries were selected to represent distinct ASEAN manufacturing contexts: Thailand, a middle-income economy with a highly developed automotive and electronics manufacturing export base and an established SCF ecosystem operated by commercial banks including Bangkok Bank and Kasikorn Bank; Indonesia, Southeast Asia's largest economy with a large and diversified manufacturing SME sector and a rapidly expanding fintech SCF platform market; and the Philippines, a lower-middle-income economy with a manufacturing sector concentrated in electronics assembly and food processing, and a nascent but growing SCF regulatory framework under the Bangko Sentral ng Pilipinas.

The final balanced panel comprised 341 SMEs, distributed as 121 in Thailand, 118 in Indonesia, and 102 in the Philippines. Of these, 178 adopted an SCF program at some point during the 2016 to 2023 observation window, while 163 remained non-adopters throughout the panel. Financial statement data were sourced from national business registry databases and supplemented by direct data collection from firm financial records under data sharing agreements. SCF adoption status, program type, platform type, and buyer relationship characteristics were verified through SCF program administrators at participating anchor buyers and financial institutions. A structured survey instrument was administered annually to collect governance and relationship quality variables not available in administrative records.

3.5. Variable Measurement

The cash conversion cycle was calculated as days sales outstanding plus days inventory outstanding minus days payable outstanding, using annual financial statement data, following Deloof (2003). Return on assets was measured as earnings before interest and taxes divided by total assets. SCF adoption was operationalized as a binary time-varying indicator taking the value of 1 from the first fiscal year of confirmed program participation, and 0 otherwise.

Buyer relationship quality was measured as a composite score averaging three dimensions: buyer relationship tenure in years (log-transformed), share of the SME's total sales accounted for by the primary anchor buyer (proxy for relationship intensity), and a survey-based rating of buyer payment reliability and communication quality, rated on a five-point scale. Anchor buyer credit rating was captured as the long-term local currency rating of the primary anchor buyer, converted to a numerical scale from 1 (below investment grade) to 7 (AAA equivalent) using a standardized crosswalk across rating agency scales. SCF platform digital maturity was assessed using a four-item scale capturing straight-through processing capability, mobile access, real-time invoice status visibility, and integration with the SME's enterprise resource planning system.

Control variables included firm age (years since registration), firm size (log of total assets), leverage (total debt to total assets), sales growth (year-on-year revenue change), industry sub-sector (coded as electronics, automotive, food processing, textiles, and other), and country-year GDP growth rate. All financial variables were winsorized at the 1st and 99th percentiles.

3.6. Analytical Strategy

The primary quantitative analysis proceeded in three stages. First, two-way firm and year fixed effects OLS regression was estimated for each outcome variable, with standard errors clustered at the firm level. While this specification controls for time-invariant confounders, it does not address the persistence of the CCC or the endogeneity of SCF adoption arising from potential selection on unobservable time-varying firm characteristics. Second, the system GMM estimator of Blundell and Bond (1998), as implemented in Stata's xtdpdsys command, was applied to both outcome equations. The GMM specification treats SCF adoption and lagged outcome variables as endogenous, using second and deeper lags as internal instruments, and employs external instruments comprising lagged anchor buyer SCF program expansion decisions and national SCF regulatory development indices, which affect individual SME adoption probability but are plausibly excludable from the firm-level performance equation. Instrument validity was assessed using the Hansen J test and the Arellano-Bond AR(2) test for second-order serial correlation.

Third, moderation analysis was conducted by including interaction terms between SCF adoption and the three moderating variables in the system GMM specification. Mediation analysis testing H6 followed the product-of-coefficients approach with bootstrapped confidence intervals using 5,000 replications (Preacher & Hayes, 2008). Semi-structured interview data were analyzed using directed content analysis with a deductive framework derived from the theoretical model, augmented by inductively generated codes capturing operationally specific mechanisms not anticipated by the framework.

IV. RESULTS

4.1. Descriptive Statistics and Pre-Adoption Trends

The full sample had a mean CCC of 64.7 days (SD = 28.3) in the base year of 2016, broadly consistent with regional benchmarks for manufacturing SMEs documented by the Asian Development Bank (2018). Mean return on assets was 6.8%

(SD = 4.2%). SCF adopters exhibited pre-adoption CCCs that were slightly longer than non-adopters (67.3 versus 61.8 days, t-test p = 0.067), suggesting a mild tendency for firms with greater working capital pressure to self-select into SCF programs. This pattern underscores the importance of addressing endogeneity in the main analysis. Pre-adoption return on assets did not differ significantly between adopters and non-adopters (6.5% versus 7.1%, p = 0.183), providing some assurance that adoption was not driven by pre-existing profitability differences.

4.2. Effect of SCF Adoption on Cash Conversion Cycle

The two-way fixed effects estimate of the SCF adoption effect on the CCC was negative and significant (beta = -14.7 days, SE = 2.8, t = -5.25, p < 0.001), providing preliminary support for H1. The system GMM estimate, which accounts for CCC persistence and adoption endogeneity, yielded a somewhat larger coefficient (beta = -18.4 days, SE = 3.4, t = -5.41, p < 0.001), suggesting that the fixed effects estimate understated the true adoption effect, likely due to attenuation from unobserved time-varying selection. The Hansen J statistic was non-significant (p = 0.347) and the AR(2) test confirmed absence of second-order serial correlation (p = 0.214), supporting instrument validity. Country-disaggregated GMM estimates revealed CCC reductions of 20.1 days in Thailand, 18.6 days in Indonesia, and 16.2 days in the Philippines, with the somewhat smaller Philippine effect reflecting the lower digital maturity of SCF platforms operating in that market during the early years of the panel.

Decomposition of the CCC effect showed that the reduction operated primarily through the accounts receivable channel: days sales outstanding declined by an average of 12.3 days post-adoption (p < 0.001), reflecting the accelerated collection facilitated by reverse factoring. Days payable outstanding increased slightly (mean = 3.1 days, p < 0.05), consistent with buyer incentives to maintain or extend payment terms within SCF program structures. Days inventory outstanding showed no significant change (p = 0.412), confirming that the SCF benefit was confined to the financial rather than the operational dimension of the working capital cycle.

4.3. Effect of SCF Adoption on Return on Assets

The system GMM estimate for return on assets confirmed a significant positive effect of SCF adoption (beta = 2.31 percentage points, SE = 0.84, t = 2.75, p < 0.01), supporting H2. The magnitude of this effect is economically meaningful given the sample mean ROA of 6.8%, representing a 34% proportional improvement attributable to SCF participation. Instrument validity statistics were again satisfactory (Hansen J p = 0.291, AR(2) p = 0.183). The ROA improvement was somewhat larger in the electronics subsector (beta = 2.89 percentage points) than in food processing (beta = 1.94 percentage points) and textiles (beta = 1.73 percentage points), consistent with the higher receivables intensity of electronics supply chains and the correspondingly greater financial benefit of accelerated collection through reverse factoring.

4.4. Moderation Analysis

All three moderation hypotheses received empirical support. The interaction between SCF adoption and buyer relationship quality was negative and significant in the CCC equation (beta = -4.6 days, SE = 1.9, t = -2.42, p < 0.05), supporting H3: SMEs with higher-quality buyer relationships achieved larger CCC reductions from SCF adoption, likely reflecting the preferential program terms, lower invoice discrepancy rates, and more rapid payment confirmation available in long-established, high-volume buyer relationships.

The anchor buyer credit rating interaction was significant for both CCC (beta = -3.2 days per rating grade, SE = 1.4, t = -2.29, p < 0.05) and ROA (beta = 0.41 percentage points per rating grade, SE = 0.18, t = 2.28, p < 0.05), supporting H4. The gradient effect of credit rating on program outcomes confirms that the pricing advantage of SCF, which is the fundamental economic mechanism, is directly proportional to the anchor buyer's creditworthiness. SCF platform digital maturity moderated the CCC reduction significantly (beta = -2.8 days per maturity unit, SE = 1.3, t = -2.15, p < 0.05), supporting H5, with firms on higher-maturity digital platforms achieving faster invoice processing, lower discrepancy rates, and more reliable financing availability.

4.5. Mediation Analysis

The bootstrapped mediation analysis confirmed that the CCC partially mediated the relationship between SCF adoption and ROA improvement (indirect effect = 0.74 percentage points, 95% CI: 0.31 to 1.21). The direct effect of SCF adoption on ROA remained significant after controlling for CCC (direct effect = 1.57 percentage points, p < 0.05), indicating partial rather than full mediation and suggesting that SCF generates ROA improvements through both working capital efficiency channels and additional pathways including reduced financing costs, improved supplier credit terms, and enhanced buyer relationship stability, supporting H6.

4.6. Interview Findings

Directed content analysis of the 28 semi-structured interviews generated four thematic domains: accelerated liquidity and reinvestment cycles, relationship capital deepening, platform experience and trust formation, and institutional barriers to program scaling.

4.6.1. Theme 1: Accelerated Liquidity and Reinvestment Cycles

SCF program participants consistently described the practical mechanism of CCC improvement in operational terms: the availability of early payment against confirmed invoices allowed them to reinitiate production cycles, replenish raw material inventory, and accept new orders more rapidly than their pre-SCF cash flow rhythms permitted. Several electronics subcontractor managers in Thailand described SCF as effectively converting a 60-day receivables cycle into a 5-day cycle, enabling a doubling of production throughput within the same capital base. This operational reinvestment effect, documented

quantitatively through the ROA improvement, emerged as the primary mechanism of profitability impact in the qualitative data.

4.6.2. Theme 2: Relationship Capital Deepening

An unexpected but recurrent qualitative finding was that SCF program participation deepened buyer-supplier relationships through channels beyond direct financial benefit. Participants described the SCF enrollment process as having prompted more structured financial information sharing with anchor buyers, which in turn led to more transparent order forecasting, production planning collaboration, and quality improvement feedback. Several Thai automotive component suppliers noted that participation in their anchor buyer's SCF program had been a prerequisite for inclusion in new model sourcing shortlists, creating a strategic dimension to SCF adoption that extended well beyond its immediate working capital function.

4.6.3. Theme 3: Platform Experience and Trust Formation

Platform digital maturity was a prominent experiential theme, with marked differences between participants using bank-administered paper-based programs and those on fully digital fintech platforms. Participants on higher-maturity platforms described substantially lower administrative burden, real-time payment status visibility that improved treasury planning confidence, and the ability to make daily early payment decisions based on current cash position rather than predetermined discount schedules. Trust in the platform emerged as a dynamic rather than static variable, with initial skepticism about data security and discrepancy resolution procedures giving way to operational confidence after several successful program cycles, a pattern consistent with Lumineau et al. (2021) in the blockchain context.

4.6.4. Theme 4: Institutional Barriers to Program Scaling

Despite widespread satisfaction with SCF benefits among adopters, several institutional barriers limiting program reach and depth were identified. First, smaller SMEs below the minimum invoice size thresholds set by bank SCF programs reported exclusion from the most competitively priced programs, creating a two-tier SCF market in which the smallest and most financially vulnerable suppliers were confined to higher-cost alternatives. Second, cross-border SCF involving suppliers and buyers in different ASEAN countries faced significant regulatory fragmentation, with differing invoice discounting regulations, foreign exchange controls, and digital signature standards across member states creating compliance complexity that deterred multi-country program expansion. Third, in Indonesia and the Philippines, a subset of SME managers expressed residual skepticism about voluntarily sharing detailed invoice and financial data with bank-administered SCF platforms, citing privacy concerns and fear of adverse credit monitoring.

V. DISCUSSION

The findings of this study make five substantive contributions to the supply chain finance, working capital management, and SME finance literatures. First, the dynamic GMM estimate of an 18.4-day CCC reduction attributable to SCF adoption is the most methodologically rigorous enterprise-level estimate of SCF's working capital effects in any published study, and the first such estimate for manufacturing SMEs in Southeast Asia. The larger GMM estimate relative to the fixed effects estimate confirms that OLS-based studies in this literature understate the causal effect of SCF adoption due to negative selection: firms with longer CCCs are more likely to adopt, biasing cross-sectional estimates toward zero. Future quantitative SCF research should routinely apply dynamic panel methods to address this identification challenge.

Second, the mediation finding that CCC improvement only partially mediates the SCF-ROA relationship suggests that working capital efficiency, while the primary theoretical channel, is not the sole mechanism through which SCF adoption generates profitability gains. The residual direct effect may reflect financing cost savings, product mix optimization enabled by more flexible production cycling, and relationship-deepening benefits documented in the qualitative findings. This multidimensional value creation architecture implies that studies limiting their scope to CCC outcomes understate the full financial impact of SCF adoption for SME participants.

Third, the moderation findings collectively map the conditions under which SCF adoption generates the largest performance returns. The convergence of high buyer relationship quality, investment-grade anchor buyer credit rating, and high platform digital maturity defines an ideal SCF adoption context that delivers the largest CCC reductions and profitability improvements. In practice, SMEs will rarely enjoy all three conditions simultaneously, and the heterogeneity of SCF outcomes documented across the sample reflects the varying combinations of these enabling conditions across the panel. SCF program designers and financial intermediaries should incorporate these moderating factors into SME eligibility and pricing frameworks.

Fourth, the ASEAN cross-country evidence reveals meaningful contextual heterogeneity that has important implications for regional SCF policy harmonization. Thailand's more advanced SCF ecosystem, established commercial bank programs, and higher digital platform maturity generates the largest per-program adoption benefits. The Philippines' smaller platform digital maturity attenuates benefits, pointing to the platform infrastructure investment gap as the most actionable policy lever in that context. Indonesia's large and diverse manufacturing SME sector, combined with a rapidly expanding fintech SCF market, positions it for proportionally the largest SCF expansion dividend if regulatory clarity and platform interoperability can be improved.

Fifth, the qualitative evidence on institutional barriers enriches the quantitative findings by identifying the minimum invoice size exclusion problem as a structural equity concern: the smallest and most financially fragile SMEs are systematically excluded from the most competitively priced SCF programs, limiting the financial inclusion potential of SCF as a policy instrument. This finding argues for the design of tiered SCF programs with lower invoice minimums, potentially supported by

credit risk-sharing arrangements between SCF platforms and development finance institutions, to extend the benefits of SCF to the full spectrum of manufacturing SME participants.

VI. CONCLUSION

This study provides the most methodologically rigorous and contextually grounded evidence to date that supply chain finance adoption generates significant and causally identified improvements in cash conversion cycle efficiency and profitability among manufacturing SMEs in Southeast Asia. The 18.4-day CCC reduction and 2.3 percentage point ROA improvement, estimated using dynamic GMM methods that address the dual challenges of working capital persistence and endogenous adoption, represent substantial and practically meaningful performance gains for an SME segment chronically underserved by conventional financial intermediation.

For ASEAN policymakers and the ASEAN Coordinating Committee on Micro, Small and Medium Enterprises, the findings argue for the prioritization of three mutually reinforcing policy tracks. First, regulatory harmonization of invoice discounting, digital signature, and cross-border payment standards across ASEAN member states would dramatically expand the addressable market for multi-country SCF programs and reduce the compliance costs that currently deter regional program expansion. Second, targeted digital infrastructure investment, including broadband access, e-invoicing system standardization, and fintech SCF licensing frameworks, would accelerate the platform digital maturity improvements that the moderation analysis identifies as a key amplifier of SCF performance benefits. Third, blended finance arrangements combining development bank credit risk guarantees with commercial SCF platform operations could extend program access to smaller SMEs currently excluded by minimum invoice size thresholds.

For commercial banks and fintech SCF platform operators, the study's evidence on buyer relationship quality and platform digital maturity as performance moderators offers concrete product design guidance. Platforms should invest in automated invoice matching, real-time confirmation workflows, and seamless ERP integration to maximize working capital acceleration for SME clients. Relationship managers at anchor buyer firms should be equipped to communicate the full strategic value of SCF enrollment to supplier SMEs, including the order preference and forecasting collaboration benefits documented in the qualitative findings.

Several limitations of this study warrant acknowledgment. The balanced panel design, while enhancing statistical efficiency, required the exclusion of firms with incomplete eight-year data series, potentially introducing survivorship bias toward more stable SMEs. The SCF adoption measure, while verified through program administrator records, does not capture variation in program utilization intensity, and future research should examine whether utilization depth mediates the relationship between adoption and performance outcomes. The study is confined to three ASEAN countries, and extension to Vietnam, Myanmar, and Cambodia, where manufacturing SME sectors are expanding rapidly, would increase the generalizability of findings. Future research should also investigate the long-run dynamics of SCF adoption on firm investment, employment, and export intensity, and examine how fintech platform competition affects the pricing and accessibility of SCF instruments for the SME segment.

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