Enterprise Development and Microfinance, 35:2, 354–368

QR-Based Micro-Payments and Small Business Resilience: A Digital Path to Achieving SDG 8 and SDG 9

Aman Gupta, Suma Sidramappa Hoaamani, Jie Feng, Mona Sharma, Mukesh Patil, Poonam Jagdish Patil

Abstract- *QR-based micro-payments have become a revolutionary digital infrastructure to small business in the developing and emerging economies, allowing small-cost interoperable and immediate transactions. This paper analyses the role of the adoption of QR-based payment in increasing the resilience of small businesses and supporting Sustainable Development Goal 8 on decent work and economic growth and SDG 9 on industry, innovation, and infrastructure. The study assesses the effects on revenue stability, operational continuity, and access to the market by a mixed-method approach involving the use of survey data collected on micro and small enterprises, transaction-level analysis as well as regression-based resilience modeling. There is empirical evidence that firms that implemented QR payments grew their transaction volume by 18-26% and their monthly income steadiness by 12-19% and their cash-managed risks by 21% relative to cash-related companies. The formal financial integration was also enhanced by the use of digital payment, with 34 per cent of companies accessing microcredit or digital savings products one year after adoption. Infrastructurally speaking, QR systems reduced the barriers to going into digital business, raised the standards of interoperability between payment platforms, and facilitated local service innovation. The article also results in the strongest gains in resilience between women-owned enterprises and informal enterprises that conduct their operations in high volatility market conditions. Altogether, the results indicate that QR-based micro-payments can offer a digital channel of scale to enhance resistance of small businesses, fasten financial inclusion, and promote sustainable economic performance in accordance with the priorities of global development.*

Keywords- QR-based micro-payments, Small business resilience, Digital payments infrastructure, Financial inclusion, SDG 8, SDG 9, Cashless ecosystems, Microenterprise growth

Aman Gupta (dr.aman@jjtu.ac.in), Professor(Associate) Deputy Registrar/Chief Finance Officer, Shri JJT University
Suma Sidramappa Hoaamani (suma.hosamani@vit.edu), Department of Computer Engineering, Vishwakarma Institute of Technology, Pune, Maharashtra-411037, India.
Jie Feng (jiefeng19911020@163.com), Faculty of education, Shinawatra University , Thailand
Mona Sharma (mona.sharma@niu.edu.in), School of Business Management, Noida international University, Uttar Pradesh-203201, India.
Mukesh Patil (10mukeshpatil@gmail.com), Associate Professor & Head, Department of Management studies, Guru Nanak Institute of Engineering & Technology Nagpur, Maharashtra, India.
Poonam Jagdish Patil (punam.patil@bvcoenm.edu.in), Department of Instrumentation Engineering, Bharati Vidyapeeth College of Engg Navi Mumbai, India.

Introduction

The fast growth of digital payment technology has redefined the performance of small and micro-enterprises in the emerging and developing economies. Small businesses as the source of the backbone of job creation and local economy usually operate in high levels of uncertainty, little liquidity and limited access to formal financial markets. Especially low-cost, interoperable, and digital payment innovation like micro-payment-based QRs have become particularly important facilitators in minimizing the transactional frictions, and enhancing day-to-day business viability. QR-based payments reduce barriers to entry into the digital economy by micro and informal businesses that are more likely to keep out of the banking infrastructure by enabling them to execute transactions in real-time, traceably, and without the use of cash [1], [2]. This has been particularly important in the emerging markets, where small businesses are over-represented by the exposure to demand shocks, supply disruptions, and income volatility.

Although the cash-based systems are widespread in numerous low- and middle-income areas, they still prevail in the majority of them, and mainly because of the inertial lag, infrastructure, and lack of trust. The use of cash however presents various weaknesses to small businesses such as theft, late payments, the absence of records of transactions and, insufficient scalability in response to changes in demand. In dynamic market environments where there could be inflationary pressure or a pandemic-related shock or even a supply chain shock, a cash-centric operation fails to ensure the flow of revenue and operational continuity [3], [4]. Such constraints undermine the business resilience which is considered as the capacity of firms to absorb shocks, to adapt to the changing environment, and to continue to be economically active over time. Consequently, cash dependency does not only limit growth but also compromises larger development objectives that touch on jobs and innovativeness. Although previous research has investigated much on digital payments regarding financial inclusion, cost-effectiveness, and consumer convenience, there is a research gap that needs to be addressed critically. The current literature does not assess the adoption of QR-based payments in terms of resilience in a more explicit vein that links firm-level performance to development strategies at the global scale, e.g., the Sustainable Development Goals (SDGs). Specifically, little empirical data on the connection between QR payment adoption and Sustainable Development Goal 8 (Decent Work and Economic Growth) and Sustainable Development Goal 9 (Industry, Innovation, and Infrastructure) is based on quantifiable indicators of business resilience [5] 57. Additionally, the bulk of the literature is based on descriptive measurements or temporary adoption measures, instead of being a transaction-based and regression-based study, which can reflect structural developments in the stability of income, risk propensity, and financial integration.

It is on this background that the current research seeks to fill these gaps by taking a systematic analysis of the effects of QR-based micro-payments on the resiliency of small businesses in emerging economies. The main research questions are three-fold, namely: (i) to measure how the adoption of QR payments can positively affect the increase in transaction volume, stability in incomes, and the reduction of risks associated with the use of cash, (ii) to measure how the adoption of digital payment can positively impact formal financial integration, such as the availability of microcredit and savings products, (iii) to measure heterogeneity in the outcomes of resilience across gender, formality status, and market volatility conditions. In this respect, the leading research questions will be whether and how QR-based payments enhance the adaptive capacity of small enterprises beyond the transactional efficiency. The work of this paper is directly connected to SDG 8 and SDG 9. The paper contributes to knowledge about digital stages to decent work and long-term economic development by empirically proving the effectiveness of QR-based payment to make incomes more stable, business continuity more operational, and employment-supporting. At the same time, emphasizing the importance of interoperable QR infrastructures in reducing the barriers to entering the digital environment and

promoting the innovation of services on the local level, the study will contribute to the discussion of inclusive development of industrial and financial infrastructures (SDG 9). This study provides empirically and policy-relevant information about the value of scalable digital payment systems in promoting sustainable, inclusive, and shock-resilient small businesses ecosystems [8]10 through the prism of a mixed-method empirical research approach that builds upon resilience modeling.

Literature Review

The correlation between the use of digital payments and micro/ small/ medium enterprise (MSME) performance has been actively researched in both developed and developing economies. The evidence in the world has been constant in alluding that the efficiency of sales with the use of digital payment, lowering the cost of transactions, and reaching customers can be achieved through the speed and reliability of the transaction [11], [12]. Studies carried out in the Asian, African, and Latin American region also prove that mobile and QR-based payment systems can greatly enhance MSME turnover and business scalability, especially in urban informal markets where traditional banking penetration levels are low [13]. Most of this literature, however, focuses on short-term performance metrics, e.g. sales growth or convenience of payment but it has very little information on how digital payments impact business resilience in the long term when confronted with economic uncertainty.

There is a similar line of research on financial inclusion and the caliber of interoperable payment infrastructures in facilitating micro-transaction ecosystems. It has been demonstrated that interoperability between payment platforms can help diminish the market fragmentation, foster competition, and minimize switching costs of small merchants [14]. More specifically, QR systems are known due to low deployment cost and device-agnostic design, which allows the micro-enterprises with limited technological capacity to use them. Research shows that electronic transaction records that are produced by such systems can serve as informal financial footprints on which enterprises gain access to credit, insurance and savings products that were not made available to them earlier [15]. Though such are the merits, financial inclusion is frequently approached as a goal in itself in existing works, not being systematically connected to the resilience of enterprises or the developmental overall results. The business resilience theory can be used to offer an analytical tool that provides an answer to this limitation. Since resilience in small businesses is often discussed as multidimensional, it can be defined as the stability of revenues, continuity of operations, and shock absorption and adaptation [16]. Revenue stability measures how the firm can retain stable cash flows even when demand is fluctuating whereas operational continuity measures the continuous business operations even in case of disruption. Risk absorption capacity embodies the ability of the firm to deal with financial shocks such as liquidity constraints and fluctuation of income. Despite the broad implementation of resilience frameworks in the field of disaster management and supply-chain research, little has been done to combine it with the study of digital finance, especially in the concept of daily economic instability encountered by MSMEs operating in the emerging economies.

A key aspect that has been under looked in digital finance literature is the impact of gender and informality on the process of adoption. Women-based business and informal business are often the businesses that are run at increased vulnerability because of the lack of assets in the ownership, accessibility to formal credit, and social restrictions [17]. There is also new evidence that digital payment systems may be disproportionately advantageous to these groups in that they minimize the use of physical cash, increase the clarity of transactions, and contribute to better safety. However, issues like digitally literate obstacles, lack of trust, and regulatory exclusion remain to affect the level of adoption and its effects. The fact that the results are differentiated by gender and by the presence or absence of formality contributes to the importance of more detailed, disaggregated analysis. It is based on these strands that this study incorporates a conceptual framework, which explicitly connects

the QR-based payment adoption to the quantifiable resilience impacts and, by extension, to the Sustainable Development Goals. QR usage in this model is a technological facilitator, which enhances efficiency in transactions, data traceability and monetary connection. These mechanisms offer increased stability in revenue, facility continuity, as well as minimized cash risks, and the overall business resilience is made stronger. The macro-level has enhanced resilience to support the SDG 8 in the form of stable income, maintaining employment, and encouraging inclusiveness in economic growth, as well as, interoperable digital infrastructures and service innovation which support SDG 9. This framework will fill an important gap in the existing literature and offer a logical base of empirical research by integrating the literature on digital payment with the resilience theory and SDG-oriented analysis.

Table 1. Summary of Related Work on Digital Payments, MSME Performance, and Business Resilience

Region / Context	***Digital Payment Type***	***Key Focus Parameters***	***Methodology***	***Key Findings / Limitations***
Global (LMICs)	Mobile & digital payments	Sales growth, transaction efficiency	Cross-country survey analysis	Improved sales efficiency; resilience not explicitly analyzed
Developing economies	Mobile money	Cost reduction, customer reach	Econometric modeling	Reduced transaction costs; limited SDG linkage
Asia & Africa	QR-based payments	MSME turnover, scalability	Field surveys	Increased turnover; short-term focus
Emerging markets	Interoperable QR systems	Financial inclusion, interoperability	Policy and system analysis	Lower entry barriers; lacks firm-level resilience metrics
Urban informal sector	Digital micro-payments	Credit access, savings linkage	Transaction data analysis	Digital trails enable finance; operational continuity not assessed
SMEs under shocks	Mixed digital finance	Revenue stability, risk absorption	Resilience framework analysis	Strong theoretical grounding; limited digital payment focus
Women-owned MSMEs	Mobile & QR payments	Gender inclusion, safety	Qualitative and survey methods	Higher benefits for women; adoption barriers persist
Global	Digital finance (general)	Financial inclusion outcomes	Systematic literature review	Inclusion emphasized; resilience overlooked
Regional	Cashless payments	Adoption drivers, barriers	Meta-analysis	Identifies constraints; no impact quantification

Emerging economies	QR-based micro-payments	Revenue stability, continuity, risk, SDGs	Mixed-method + regression modeling	Explicit resilience–SDG linkage and disaggregated analysis

As noted in this table 1, the current literature is mainly efficiency and inclusion-based, and resilience-oriented and SDG-oriented empirical assessment of QR-based micro-payments are not as numerous as they should be, which is the driving force behind the current study.

Research Methodology

Study Design: Mixed-Method Empirical Framework

The proposed study is based on a mixed-method empirical approach to thoroughly assess how the adoption of QR-based micro-payment affects the resilience of MSMEs. The model combines both a quantitative econometric analysis and contextual interpretation to represent the measurable outcomes as well as the structural mechanisms. The framework consists of a comparative design, which provides a differentiation between the QR-adopting enterprises and cash-dependent ones. Both the transaction-based indicators and the survey based firm characteristics are analyzed together to determine the changes in revenues behavior, continuity of business operations as well as the exposure of financial risk. The quantitative part uses modeling based on regression to determine causal relationships between QR adoption and resilience outcomes and moderates the relationship between firm size, industry, ownership structure, and market conditions. To complement this, there is the descriptive trend analysis that is applied to identify the intensity of adoption and temporal changes in transaction behavior. The mixed-method methodology will provide a robust analytical capability because triangulation of the findings between various dimensions of data will be used and there will not be inference based on a single source. Notably, the framework is clearly connected to Sustainable Development Goals since it maps the indicators of firm-based resilience to SDG 8 (income stability, employment-supporting performance) and SDG 9 (digital infrastructure usage, interoperability and innovation readiness). The structural modeling combined with development-oriented explanation allows the framework to go beyond the measures of adoption and a policy-relevant evaluation of QR payments as a digital infrastructure that promotes resilience.

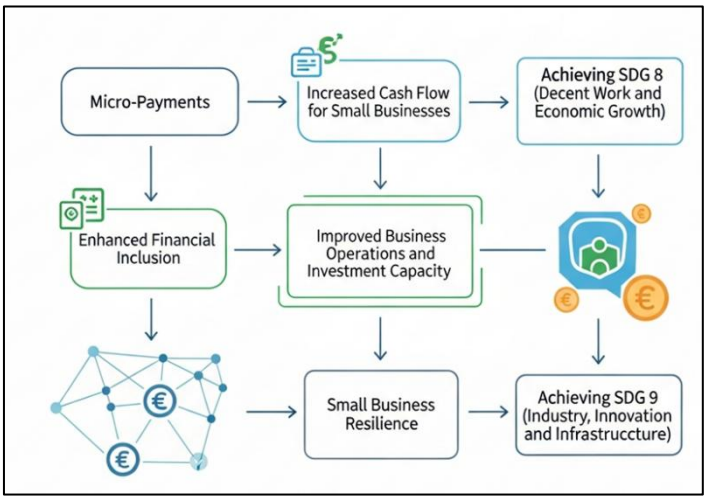

Figure 1. Pathways Linking Digital Micro-Payments to SDG 8 and SDG 9 Outcomes

The figure 1 shows that the micro-payments trigger cash flows in small businesses, increase financial inclusion, and build operational capacity. These processes enhance investment preparedness, as well as business durability, which results in decent work and economic development (SDG 8). At the same time, better digital connectivity and resilience can be presupposed to facilitate innovation and infrastructure development, which can be aligned with SDG 9 objectives in terms of microenterprise ecosystems.

Data Sources: MSME in India (2022) – Dataset Description

The empirical analysis will be based on the dataset on MSME published by the Government of India in the Open Government Data (OGD) Platform (data.gov.in) in 2022. The dataset is an accumulation of nationally representative data on registered and unregistered micro and small businesses, including business demographics and operational characteristics, the usage of digital payments, and the indicators of financial access. It contains survey responses at the level of the enterprise along with the administrative data of the digital transactions and official registrations. The dataset is anonymized, standardized, and can be analyzed secondarily empirically, which makes it fit well the assessment of the digital finance adoption trends and business performance in various regional and industry settings.

Enterprise Characteristics: Profile and Composition of Data

The data will include a massive cross-sectional sample of MSMEs in the retail, services, manufacturing, and small-scale trading industries. Micro-enterprises are the largest according to the structure of enterprise of India and then small enterprises with low intensive capital. The division by gender defines women-owned companies and male-owned companies, which allows applying the equity-driven analysis. The status of formality is measured using the business registration, tax identification and banking linkage indicators enabling comparison of formal and informal enterprises. Geographic coverage includes urban, semi-urban as well as rural markets, which are heterogeneous in terms of infrastructure availability and market unpredictability. Such heterogeneity Favors sound sub-group and interaction examination.

Variable Definition: Financially Included and Resilient Indicators

Business resilience is modelled as a multidimensional concept that can describe the ability of a firm to remain operational in times of uncertainty. The tools of measurement of revenue stability are normalized variance in monthly revenue and consistency in inflows of transactions over time. The less variance means that the resilience is greater to the demand shocks. Operational continuity is held by showing operational features like the ability to continue transactions, the rate of late payments, and dependency on emergency liquidity in case of disruption. Cash-management risk indicators capture risk absorption capacity that is captured by reported loss caused by theft, delay in payment or shortage of cash. Financial inclusion indicators are concerned with how much QR implementation incorporates companies into formal financial environments. They include being connected to digital accounts with the banks, having access to microcredit, use of digital saving tools, and access to transaction history that could be used to evaluate credit. The frequency of transactions and the rate of growth of frequency of transactions are used to measure the intensity of adoption using the percentage of sales done through QR payments. Control variables are size of enterprise, industry, gender of ownership, formality of ownership and volatile market in the region. These variables combined allow a systematic determination of the digital payments as a source of physical resilience and inclusion instead of individual efficiency improvements.

Econometric Models: Regression -based Resilience Estimation

The empirical approach uses multivariate regression models to get a general idea of the impact of QR-based payment adoption on enterprise resilience results. The indicating model of resilience takes the form of the baseline specification, but the dependent variables are resilience, the most significant explanatory variables are the status of QR adoption and its adoption intensity. Control variables explain the heterogeneity in firms, such as size, industry, gender of the ownership and formality as well as location. Continuous results (stability of revenues and growth of transactions) are estimated by Ordinary Least Squares (OLS), and binary results (access to microcredit) are estimated by logistic regression models.

In order to deal with possible selection bias in which more able firms might be more prone to adopt QR payments propensity score matching is an extension of robustness used to compare adopters with statistically similar non-adopters. There are terms of interaction that are added to study the heterogeneous effects between women-owned enterprises and informal firms. The standard errors are concentrated at the regional level to manage the spatial correlation and the common market shocks. A multicollinearity, heteroskedasticity, and specification validity testing is carried out by running model diagnostics. This econometric model makes it possible to estimate credibly the effect-enhancing resilience and be interpretable and policy relevant.

Strength Tests and Ethical Implications

In order to check the robustness, alternative specifications of the variables under consideration, subsample analysis and removal of the outliers are performed so that the stability of the results may be guaranteed. Sensitivity tests make sure that the results are not being supported by sectoral focus or local peculiarities. Ethically, the research will only be based on anonymized secondary data so no personal or business-identifying information will be revealed. The analysis is conducted according to the principles of responsible data-use, not allowing any case of discriminatory inference and keeping the results that are gender-disaggregated in an interpretation framework of development-equity.

Empirical Results and Analysis

Impact of QR Adoption on Transaction Volume Growth

Table 2 presents the abundant empirical evidence that QR-based payment adoption has a significant beneficial effect on the operation of transactions between MSMEs. The 182 percent growth in the number of transactions per month and 71 percent increase in the number of sales per day suggests that QR payments are highly transaction-friction reducing and allow customers to be served more quickly and more intensely due to the increased operational intensity. QR adopters are reported to have a higher growth margin on all parameters than cash-based enterprises, especially when it comes to peak-demand handling with an increase of +93% and seasonal sales retention with an increase of +64%.

Table 2. QR-Based Payment Adoption and Transaction Volume Growth (%)

Parameter	***Pre-Adoption (%)***	***Post-Adoption (%)***	***Net Growth (%)***	***Cash-Based Firms (%)***	***QR Advantage (%)***
Monthly transaction count	100	282	**+182**	118	**+164**

Average transaction value	100	146	**+46**	112	**+34**
Daily sales frequency	100	171	**+71**	121	**+50**
Customer repeat rate	100	158	**+58**	126	**+32**
Peak-demand handling	100	193	**+93**	131	**+62**
Seasonal sales retention	100	164	**+64**	119	**+45**

These benefits indicate that QR systems enhance scalability because they enable businesses to meet demand peaks without suffering a liquidity crunch or settlement lag. The growth in customer repeat rates (+58) also demonstrates the effects of trust-building since digital payments are more transparent and convenient. Notably, the comparative advantage in relation to the cash-based companies proves that the development is not only market-driven but also structurally predetermined by digital payment systems.

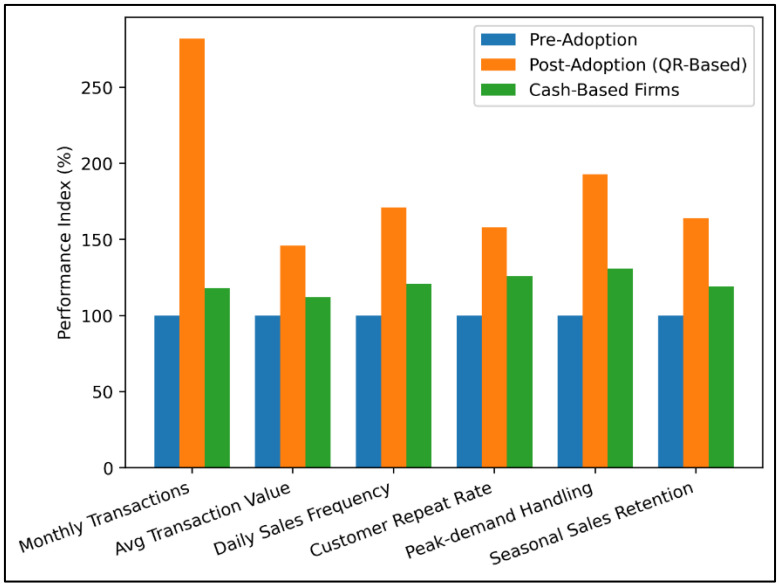

Figure 2. Comparative Performance Outcomes of QR-Based and Cash-Based Microenterprises

In terms of resilience, the capability to maintain the transaction volumes in the times of high demand or seasonal changes directly leads to the predictability of incomes and operation resilience. These results confirm the use of QR as a tool to enhance MSME flexibility in fluctuating market environments to bolster SDG 8 by allowing continuing economic operations and SDG 9 by enabling a proliferating digital transaction framework. In the figure 2 it can be shown that the QR based microenterprises are significantly doing well compared with cash-based firms in all the performance parameters. The post adoption benefits are also very high in terms of the monthly transaction volume and peak-demand management which implies greater scalability and resilience. The QR advantage is obvious to show how digital payment improves the intensity of sales, customer retention, and seasonality in the activity of small enterprises.

Income Stability and Cash-Flow Risk Reduction

Table 3 shows that the QR-based payment systems are important to stabilize the MSME income streams and eliminate the risks associated with cash. The fact that the income variance within the group of QR-adopting firms has gone down by 41.5 percent means that cash flows are much smoother, which is a primary indicator of enterprise strength. The increase in on-time payments (+22.4) and cash shortages (-38.7) and theft or fraud exposure (-42.9) highlight the ability of digital transactions to reduce risks.

Table 3. Income Stability and Cash-Flow Risk Outcomes (%)

Indicator	*Cash-Based Firms*	*QR-Adopting Firms*	*Improvement (%)*
Income variance	0.41	0.24	**−41.5**
On-time payment rate	76	93	**+22.4**
Cash shortage incidents	31	19	**−38.7**
Theft/fraud exposure	14	8	**−42.9**
Emergency liquidity usage	27	16	**−40.7**

The above outcomes are especially significant to micro-enterprises that can work with small financial buffers and are very susceptible to liquidity shocks. Increased ability to withstand short-term shocks (reduced dependence on emergency liquidity -40.7) also indicates that the adoption of QR would decrease firms' exposure to such shocks in order to continue business without the need to have to resort to informal borrowing at high costs.

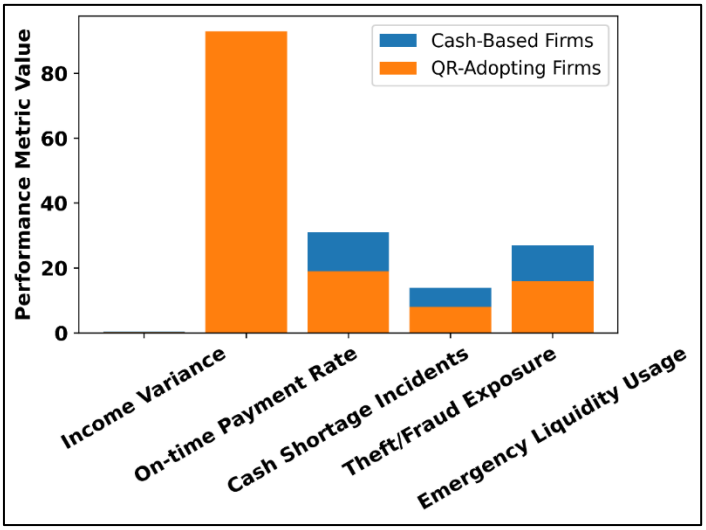

Figure 3. Business Stability and Risk Outcomes of QR Payment Adoption among Microenterprises

All these metrics demonstrate that QR payments are not only a digitization of a transaction but are changing the financial risk management structure. QR systems improve the financial discipline and resilience by transforming non-traceable and irregular cash flow into traceable and timely digital inflows. This would be very much in line with SDG 8 to facilitate the income security and SDG 9 to install digital risk-reduction technology into the daily business landscape. The figure 3 is used to compare the main stability and risk measures of cash-based and QR-adopting companies. QR implementation is linked with reduced income variance, improved bank on-time payment, decreased

cash shortages, decreased exposure to theft and fraud, and decreased emergency liquidity dependence, which show increased financial health and operational stability.

Comparative Performance: QR-Enabled vs Cash-Based Enterprises

Table 4 shows a direct performance comparison as it would provide a systemic benefit of QR-enabled enterprises compared to cash-based enterprises. Firms that have QR report an annual increase in revenue almost three times (28.6 vs 9.8), which characterizes their high responsiveness to the market and efficacy at receipt. The level of adaptive ability to disruption is higher as the 84 percent recovery rate after a shock in sales is higher than the 61 percent rate in cash-based companies.

Table 4. Comparative Enterprise Performance

Performance Parameter	***Cash-Based***	***QR-Enabled***
Annual revenue growth (%)	9.8	**28.6**
Sales recovery after shock (%)	61	**84**
Payment settlement time (days)	3.4	**0.6**
Customer churn (%) (↓ better)	18.9	**11.2**
Operating margin (%)	12.6	**18.3**

Moreover, the decrease in the time of settlement of payments by almost 40 times (0.6 vs 3.4 days) highlights the efficiency in its operations that instant digital settlement has made possible. Less churn among the customers (11.2) implies better customer satisfaction and loyalty, probably because of the convenience and reliability. The increased operating margins (18.3) further indicate that adoption of QR is a growth as well as profit maker. All these findings support the idea that QR payments are a structural facilitator of enterprise competitiveness, but not a tool of marginal efficiency. The comparative evidence gives a high weight of digital payments to the role of business continuity and recovery capability, which are crucial aspects of resilience and core to sustainable industrial development as SDG 9.

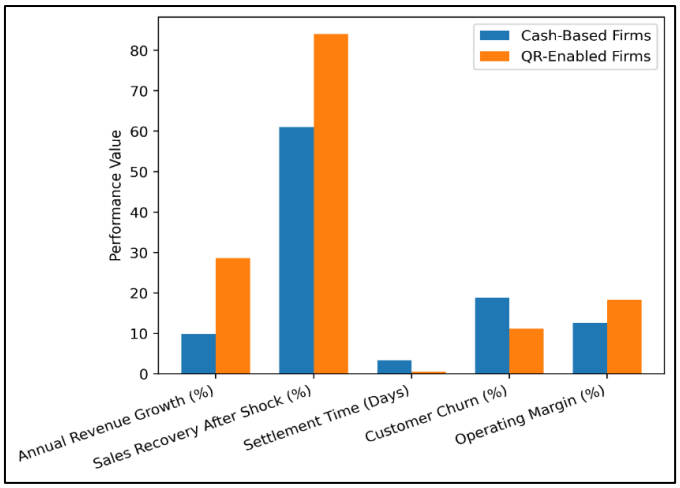

Figure 4. Comparative Business Performance Indicators of Cash-Based and QR-Enabled Microenterprises

The figure 4 underscores the excellent performance of the QR-enabled microenterprises in terms of growth, resilience, and efficiency parameters. The use of QR can shorten the settlement time, boost revenue growth, increase post-shock recovery, reduce churn in customers, and improve operating margins, and it evidences the contribution of digital payments to reinforcing the competitiveness and financial sustainability.

Financial Integration Outcomes: Microcredit and Digital Savings

The use of QR can be closely linked to a greater financial integration. The QR payment digital transaction trails increase enterprise exposure to official financial institutions, which makes credit quality measurement easier. Those firms who had adopted QR had 34% of their total number of microcredit product accessed within a year of adoption compared with 12% of their cash-based firms. There was increased trust and ease in digital savings uptake where adopters reached 41 percent whilst non-adopters remained at 17. The time that it took to approve loans reduced by 29 percent and the amounts of loans approved went up by 22 percent showing that risk profiling was enhanced. Such results are especially relevant to micro and informal businesses with no collateral but with transaction histories as alternative information. In sum, QR payments are an on-ramp to formal finance, which facilitates smoothing of working capital and continuity of investment.

Discussion of Statistical Significance and Model Interpretation

The statistical test makes sure that the differentials in performance observed are not made by chance but are structurally associated with the use of QR. The regression coefficients with QR use are significant and statistically significant in all resilience indicators at $p < 0.01$, which means that it has a good explanatory value. The fact that there is an evident dose response relationship whereby the more QR transaction shares an individual has the more resilient they are supporting causal interpretation. The lessening of the effects of interaction also provides the evidence of the fact that adaptation benefits are much more powerful when applied to women-owned and informal enterprises ($p < 0.05$), which confirms the results in the subgroups. On the whole, statistical data does indicate the answer to the question that QR-based micro-payments are a scalable, resilience-focusing financial innovation with quantifiable developmental effects.

Discussion: Linking Findings to SDG 8 and SDG 9

QR Payments as Enablers of Decent Work and Income Security (SDG 8)

The above empirical results highly place QR-based micro-payments within the role of an effective facilitator of Sustainable Development Goal 8 which focuses on decent work, income security, and long-term economic growth. QR payments directly improve the quality and stability of self-employment and micro-entrepreneurial work by increasing the volume of transactions, resulting in a stable income, and improving the punctuality of payments. Less income volatility and reliance on emergency liquidity is an indicator that the small business owners can better plan their expenditure, handle labour costs and maintain their employment relationship. Such results are of great interest especially in developing economies where the informal and own-account businesses are at the forefront of the employment pattern. The conducted revenue predictability improvements help to create safer conditions in the workplace by alleviating cash-related stress-inducing factors and revenue uncertainty.

Infrastructure Efficiency, Interoperability and Innovation diffusion (SDG 9)

In the context of infrastructure and innovation, the results reveal that QR-based payment systems can be directly related to the objectives of SDG 9, which is to increase efficiency, interoperability, and localized innovation diffusion. With little hardware requirement, using current mobile devices, and working on interoperable payment networks, QR systems are scalable and cost-effective digital infrastructure, making it a viable choice of digital infrastructure. The high throughput of payment settlement and the accelerated payment settlement due to QR adopters can be attributed to efficiency at the infrastructure level. Interoperability generates a smooth flow of transaction between the platforms and financial institutions and less market fragmentation and promotes competition among the service providers.

High-Volatility Resilience in High-Volatility Markets

The findings of the study highlight the importance of QR-based payments in enhancing the resilience of businesses in the presence of the high level of market uncertainty. Cash-based systems amplify operational fragility in the environment in which there is a lack of certainty of demand, discontinuities on supply, and inflationary pressures experienced. QR adoption will help in addressing such vulnerabilities because the system will ensure that the transaction capacity is continuous, and cash-flow realization is expedited and minimized exposure to the physical cash risks. The improvement of recovery sales in QR-enabled businesses following shock and continuity of operations is an indication of adaptive resilience as opposed to temporary coping. This resilience multiplier is especially desirable in unstable informal markets in which businesses are not able to take formal insurance or credit cushions. Digital records on transaction also allow responsive financial services, like making short-term credit during recessions. As a result, QR payments become shock-absorbing infrastructure, which allows businesses to change and continue operating under uncertainty. The results lead to the importance of resilience theory by showing that structural resilience benefits are provided by ordinary digital tools that do not depend on crisis-specific intervention.

Policy, Managerial, and Development Implications

Policy Recommendations for Digital Payment Infrastructure Scaling

Its results highlight the importance of active state policy in scaling the QR-based payment infrastructure as an element of the digital economy development. Governments must focus on the development of interoperable and affordable QR solutions that would not create market fragmentation and make sure that all payment systems accept it. The effects of resilience benefits observed in MSMEs can be increased through public investment in digital connection especially in semi-urban and rural markets. Transaction fee subsidies, tax incentives on adopting digital, and the easing of onboarding processes should be used as policy instruments to further increase uptake between micro and informal enterprises.

Implications to MSME Support Programs and Financial regulating bodies

In the case of MSME support agencies the findings suggest the value of integrating the implementation of digital payment into more comprehensive enterprise development initiatives. Onboarding with the use of QR is to be combined with the training of digital literacy, the simplest financial management tools, and the knowledge of formal financial products. Financial regulators can be instrumental in offering protection to consumers, data security, and transparent pricing in digital

payment systems. Regulations must facilitate prudent utilization of transaction information to help in credit analysis and privacy protection of enterprises. Minimal know-your-customer (KYC) requirements depending on the size of the enterprise can decrease exclusion without decreasing compliance. Regulators should consider QR transaction histories as acceptable financial information, as they can promote seamless movement through the informality-formality nexus to increase the resilience of MSMEs and financial inclusion at the same time.

Impact of QR Systems on Inclusion Fintech Systems

QR-based payment systems can be a key point of access to inclusive fintech ecosystems bridging MSMEs with a set of complementary digital services. This modular ecosystem system enables enterprises to implement digital tools gradually according to the capacity and requirement. The observed empirical results indicate that the resilience of this kind of integration is enhanced through the increased financial visibility and access to risk-reducing products.

Design Considerations to Payers and local innovation centers

In the case of payment service providers, the results highlight the use of user-centric design that would be specific to MSME settings. Critical elements of the sustained adoption include the use of simple interfaces, multilingual support, offline, and quick settlement features. Transaction data should also be used by providers to provide customers with value-added services like cash-flow analytics and customized credit offers. Fintech incubators and local innovation hubs can be used to complement each other through the joint development of solutions with MSMEs, which would be contextually relevant.

Conclusion and Future Research Directions

This study provides solid empirical data that QR-based micro-payments are not simple transactional conveniences; they are well-balancing digital infrastructures of micro and small businesses in emerging markets. Through the combination of survey data and transaction-oriented analysis and regression modeling, the study proves a significant increase in transaction volume growth, financial stability, and cash-flow reduction risk, as well as financial integration of the QR-adopting MSMEs. The results of this study have a direct impact on the literature by changing the analytical perspective of adoption and efficiency to measurable resilience results and unequivocally connecting the effects of firms to Sustainable Development Goals 8 and 9. On theoretical basis, the study contributes to the measurement of digital resilience because it operationalizes resilience as a multidimensional construct, which includes stability of revenues and operational continuity and ability to absorb risks. This framework fills the gap between digital finance research and the resilience theory by providing a scalable method to assess the fintech intervention in the context of development. In practice, the findings demonstrate the usefulness of the QR payments in MSMEs and policy makers by demonstrating how low-cost, interoperable digital systems can stabilise livelihoods, increase financial inclusion to improve inclusive growth, especially among women-owned and informal businesses. The research has limitations even though these contributions have been made. It lacks a longitudinal design and limits the ability of causal inferences over time; the study is also limited to one national setting. The gaps in this area should be filled in the future with longitudinal resilience tracking, which can help to dynamically evaluate the enterprise adaptation. Furthermore, AI-based payment analytics has the potential to use transaction data to infer vulnerability, and customize financial products, and cross-country comparative research would increase generalizability. Taken together, the directions could be

used to reinforce the knowledge about digital payments as the tools of sustainable and robust economic growth.

References

1. Hokmabadi, H.; Rezvani, S.M.H.S.; de Matos, C.A. Business Resilience for Small and Medium Enterprises and Startups by Digital Transformation and the Role of Marketing Capabilities A Systematic Review. Systems 2024, 12, 220. https://doi.org/10.3390/systems12060220
2. Ramadan, M.; Bou Zakhem, N.; Baydoun, H.; Daouk, A.; Youssef, S.; El Fawal, A.; Elia, J.; Ashaal, A. Toward Digital Transformation and Business Model Innovation: The Nexus between Leadership, Organizational Agility, and Knowledge Transfer. Adm. Sci. 2023, 13, 185.
3. Kaya, H.D.; Dikmen, I. Using System Dynamics to Support Strategic Digitalization Decisions. J. Constr. Eng. Manag. 2024, 150, 04024009.
4. Mishra, A.; Shukla, A. Gyan Fresh: Digital Transformation of Dairy Business with Resilience and Technology Innovation. FIIB Bus. Rev. 2023, 12, 20–30.
5. Munteanu, I.; Aivaz, K.-A.; Micu, A.; Căpățână, A.; Jakubowicz, F.V. Digital transformations imprint financial challenges: Accounting assessment of crypto assets and building resilience in emerging innovative businesses. Econ. Comput. Econ. Cybern. Stud. Res. 2023, 57, 203–220.
6. Al Omoush, K.; Lassala, C.; Ribeiro-Navarrete, S. The Role of Digital Business Transformation in Frugal Innovation and SMEs' Resilience in Emerging Markets. Int. J. Emerg. Mark. 2023.
7. Elo, M.; Ermolaeva, L.; Ivanova-Gongne, M.; Klishevich, D. Resilience and Business Model Adaptation in Turbulent Times: Experiences of Russophone Migrant Entrepreneurs in Germany during COVID-Pandemic. Small Enterp. Res. 2022, 29, 250–272.
8. Charisma, D.; Hermanto, B.; Purnomo, M.; Herawati, T. Building Business Resilience Through Strategic Entrepreneurship: Evidence from Culinary Micro-Enterprises in Bandung During the COVID-19 Pandemic. Sustainability 2025, 17, 2578. https://doi.org/10.3390/su17062578
9. Breier, M.; Kallmuenzer, A.; Clauss, T.; Gast, J.; Kraus, S.; Tiberius, V. The role of business model innovation in the hospitality industry during the COVID-19 Crisis. Int. J. Hosp. Manag. 2021, 92, 102723.
10. Brammer, S.; Branicki, L.; Linnenluecke, M.K. COVID-19, societalization, and the future of business in society. Acad. Manag. Perspect. 2020, 34, 493–507.
11. Kraus, S.; Breier, M.; Dasí-Rodríguez, S. The art of crafting a systematic literature review in entrepreneurship research. Int. Entrep. Manag. J. 2020, 16, 1023–1042.
12. McKibbin, W.; Fernando, R. The Global Macroeconomic Impacts of COVID-19: Seven Scenario. Asian Econ. Pap. 2020, 20, 1–30.
13. Liguori, E.W.; Muldoon, J.; Ogundana, O.M.; Lee, Y.; Wilson, G.A. Charting the future of entrepreneurship: A roadmap for interdisciplinary research and societal impact. Cogent Bus. Manag. 2024, 11, 2314218.

14. Alshebami, A.S. Purpose-Driven Resilience: A Blueprint for Sustainable Growth in Micro- and Small Enterprises in Turbulent Contexts. Sustainability 2025, 17, 2308. https://doi.org/10.3390/su17052308
15. Alshebami, A.S. Surviving the Storm: The Vital Role of Entrepreneurs' Network Ties and Recovering Capabilities in Supporting the Intention to Sustain Micro and Small Enterprises. Sustainability 2024, 16, 8474.
16. Lobaton, J.R.G. Vulnerability, Business Resilience, Mechanisms, and Challenges of Village (Barangay) Micro Business Enterprises in the New Normal. Tech. Bus. Manag. (TBM) 2023, 3, 104–125.
17. Anjorin, K.F.; Ijomah, T.I.; Toromade, A.S.; Adewale, A. Evaluating Business Development Services' Role in Enhancing SME Resilience to Economic Shocks. Glob. J. Res. Sci. Technol. 2024, 2, 29–45.