# FIRMS AND DIGITAL PAYMENTS: EVIDENCE FROM CENSAL MICRODATA

Retail Finance Distribution (ReFinD) Research Initiative
Ghana Statistical Service (GSS)

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ReFinD POLICY PAPER 02

INSTITUTE OF STATISTICAL, SOCIAL & ECONOMIC
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*March 2025*

*Published by the*
Institute of Statistical, Social and Economic Research (ISSER)
College of Humanities
University of Ghana, Legon, Ghana
E-mail: isser@ug.edu.gh
Website: www.isser.ug.edu.gh
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ReFinD POLICY PAPER 02



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## About ReFinD

*ReFinD is a sub-grants-awarding research initiative that aims to support interventions that will effectively expand the reach and efficiency of agent network operations through public policy and commercial solutions that can plausibly be scaled. It is implemented by the Institute of Statistical, Social and Economic Research (ISSER), University of Ghana, with funding from the Bill & Melinda Gates Foundation. The Initiative focuses on research based in LMICs in Sub-Saharan Africa, South Asia, and Southeast Asia. It aims to deepen digital financial inclusion among the vulnerable and excluded, including women, poor households, MSMEs, rural communities.*
*Website: www.refind-isser.ug.edu.gh*

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Other authors include Anthony Krakah (Ghana Statistical Service) who is the coordinator of the IBES census and Afarebea Vida Agyen (afarebea.ag@gmail.com) who provided excellent research assistance.

This research program is a multi-year, multi-stakeholder partnership between the ReFinD Research Initiative (ReFinD) at ISSER and the Ghana Statistical Service (GSS).

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# Executive Summary

Advancing digital payments for firms is an essential building block for business performance and financial inclusion. This report provides an in-depth analysis of digital financial services (DFS) adoption and usage among all firms in Ghana, utilizing data from the Integrated Business Establishment Census (IBES) 2024. The analysis covers 1.9 million firms across the country, focusing on the patterns of digital payments adoption and usage, the determinants of adoption and usage, and the barriers different firms face.

The findings emphasize the significant role that firm size, sector, formality, gender, and geographic factors play in shaping the adoption and usage of digital payment technologies. While personal mobile money accounts remain the commonest—even among larger firms—merchant accounts correlate with stronger business growth and formalization. Barriers, such as knowledge gaps, fraud concerns, and uncertainty about returns, hinder broader adoption and usage, particularly among informal, agricultural, and female-owned enterprises.

Female-owned businesses are smaller, less profitable, and less likely to be formalized or to adopt digital payments . However, in male-owned firms, female managers—especially when supported by female workers—drive revenue growth and digital financial adoption and usage. This effect is particularly evident among small, formal, and service-sector businesses.

# Key Findings

1. ***37% of all businesses in Ghana have adopted digital payment systems.***

Digital payments adoption is gaining traction among Ghanaian businesses, with 37% using digital payment systems—making it the most prevalent non-cash payment method. The service sector leads in adoption, with 38.3% of businesses integrating digital payments, while the agricultural sector lags behind with 22.4% (Section 2.1)

2. ***Revenue, geography, and formality are key drivers of digital payments adoption.***

Adoption rates are higher among formal, larger, and high-revenue firms. For instance, 71% of firms generating annual revenues exceeding GH₵20 million have adopted digital payment solutions, compared to 31% of firms generating less than GH₵10,000 annually. There are variations in digital payments adoption in and among districts, with higher proportions observed in regional capitals and districts in the Greater Accra Region. Digital merchant payments adoption remains low across the country, and highly clustered in the Greater Accra Region (Sections 2.2, 2.3, and 2.4).

3. ***Personal mobile money accounts for doing business remain more prevalent than merchant accounts, even among larger and formal firms.***

Micro and small firms are more likely to adopt digital payment technologies through costlier channels, such as P2B transactions using personal mobile money accounts. Larger firms diversify payment methods to reduce transaction fees but predominantly use personal accounts over merchant accounts. A negative correlation between personal and merchant account adoption suggests that firms using personal accounts perceive less value in adopting dedicated business accounts (Section 2.4).

4. ***Digital payments adoption is positively associated with business growth, particularly through merchant accounts.***

Firms that adopt digital payments are more likely to experience growth in employment and revenue generation, and are more likely to formally register operations. The adoption of a merchant account is linked to greater business growth compared to general digital payments adoption, indicating that business-specific tools provide distinct advantages for scaling operations and achieving formalization (Section 3.2).

5. ***Lack of knowledge, fraud concerns, and uncertainty about returns are key barriers to digital payments adoption, disproportionately impacting informal businesses, agricultural firms, and female-owned enterprises.***

The analysis reveals that lack of knowledge (reported by 51.2% of firms), concerns about fraud, and uncertainty regarding returns from digital payment technologies are major barriers to adoption. These challenges are pronounced among informal businesses, agricultural firms, and female-owned businesses, indicating the need for targeted interventions (Section 4).

6. ***Female-owned businesses face significant disadvantages in size, revenue, formalization, and digital payments adoption.***

Female-owned businesses are smaller, younger, and less profitable than male-owned firms. Averagely, female-owned firms employ 0.761 fewer employees (20% less) and are 0.432 years younger, indicating challenges in sustaining growth. Revenue disparities are pronounced, with female-owned businesses being 12.1 percentage points less likely to achieve high revenue (defined as above GH₵10,000). Moreover, female-owned firms are 5.2 percentage points less likely to be formally registered. Sectoral patterns further reveal that female-owned businesses are 3.9 percentage points more likely to operate in the services sector and 3.5 percentage points less likely to be in agriculture (Section 5.1).

Female-owned firms are 9.3 percentage points less likely to adopt digital payments than male-owned firms, even after controlling for firm characteristics. A persistent 7.2 percentage-point gap remains, suggesting that firm characteristic do not fully explain the difference. Moreover, female-owned firms see weaker revenue benefits from digital adoption compared to male-owned counterparts (Section 5.2).

7. ***Female managers play a pivotal role in driving revenue and digital merchant account adoption compared to businesses with only male owners and managers.***

Female-managed businesses with no female ownership are 2.9 percentage points more likely to achieve high revenue (over GH₵10,000 in 2023) and 4.9 percentage points more likely to adopt merchant accounts compared to male-owned and managed businesses. However, businesses with both female owners and managers underperform across outcomes, with a 10.7 percentage-point lower likelihood of high revenue and a 4.4 percentage-point lower likelihood of merchant account adoption (Section 5.3).

Descriptive evidence indicates the revenue premium associated with female managers is more pronounced in small businesses with 6-30 persons, formally registered firms, and businesses operating in the service sectors, particularly in the Greater Accra and the Eastern regions. This revenue premium for female managers is even stronger when supported by female workers.

# Methodology

The study employed descriptive analysis, econometric methods, and machine learning techniques, including Ordinary Least Squares (OLS) regression with fixed effects, and Least Absolute Shrinkage and Selection Operator (LASSO) regression. These methods enable us to identify the most important factors associated with digital payments adoption, while controlling for regional and firm-level characteristics.

# Policy Implications

1. ***Enhancing digital payments adoption requires targeted interventions to address knowledge gaps, fraud concerns, and uncertainty about returns.***

To bridge the adoption gap, policymakers should implement financial literacy programs, fraud prevention initiatives, and incentive structures that encourage businesses to transition from personal to merchant accounts. Simplifying the registration process for merchant accounts, particularly for small and informal firms, can further support digital payments adoption. Additionally, digital payment providers and regulators should collaborate to build trust by promoting secure and transparent digital transactions.

2. ***Addressing gender disparities in digital payments adoption is crucial for fostering inclusive economic growth.***

Female-owned firms are less likely to adopt digital payments, placing them at a disadvantage in revenue generation and formalization. However, female-managed businesses, particularly small-sized firms, demonstrate high adoption of merchant accounts, which improves revenue outcomes. Policies aimed at expanding credit access for female-owned firms, facilitating mentorship and management opportunities, and integrating digital financial tools into women-focused business support programs could help create a more level playing field.

3. ***Regional disparities in digital payments adoption highlight the need for localized policy interventions and infrastructural development.***

Businesses in northern Ghana lag behind businesses in the south in digital payments adoption, reflecting broader economic and infrastructural divides. To address this, investments in digital payment infrastructure, mobile connectivity, and financial education campaigns should be tailored to regions with lower adoption rates. Additionally, collaboration between financial institutions, telecom operators, and government agencies can help to design region-specific solutions to encourage digital payments adoption, ensuring that all businesses, regardless of location, benefit from financial technology advancements.

# 1 The IBES Census and Digital Payments Module Description

## *1.1 The IBES census*

IBES is an economic census conducted by the GSS to enumerate businesses across all sectors of the Ghanaian economy. Its primary objectives include creating an updated Statistical Business Register and generating data to inform prudent business decisions and national development.

The most recent IBES census commenced in January 2024 to update the business register. This phase involved a comprehensive listing of all business units, regardless of their characteristics—formal or informal, large or small, urban or rural, and including both physical and online establishments. Data covered key attributes, such as business activities, locations, ownership structures, establishment age, and size.

## *1.2 Digital Payments Module*

Five questions on digital financial services were included in the 2024 IBES census (Appendix 1). The first question asked firms about the payment systems used or accepted for transactions, including cash, cheques, bank transactions, and digital payments . If a firm had adopted digital payments , a follow-up question was asked about the specific tools being used. The tools included personal mobile money, merchant payments (e.g., MoMoPay), QR codes, POS devices, payment aggregators (e.g., Zeepay), card payments (e.g., e-zwich, debit/credit cards), and internet/mobile banking. The third question explored the specific purposes for which digital payments was used, including paying employees, settling bills, paying suppliers, and accepting payments from customers or the government. These purposes reflect the versatility of digital payments in business operations, highlighting its role in streamlining various financial processes.

Firms were also asked about perceived benefits, including reduced travel time, preventing theft, expanding market reach, building credit history, and improving liquidity management. These benefits contribute to overall business growth by enhancing operational efficiency, increasing customer base, and optimizing financial resources. Finally, firms that had not adopted digital payments were queried about the barriers preventing adoption, such as lack of knowledge, concerns about fraud, and uncertainty about returns. This structured approach provided a detailed understanding of the drivers of, and obstacles to digital payments adoption among Ghanaian businesses.

### 1.3 Summary Statistics and Distribution of IBES Respondents

The business census included 1.9 million firms and provided a comprehensive overview of Ghana's business landscape (Table 1). Approximately 91% are micro firms with 1-5 persons engaged, and 68% earn an annual revenue less than GH₵10,000. Majority (96.4%) are privately owned, while 3.1% are state-owned. Public-private partnerships (PPPs) are rare, comprising only 0.47% of businesses.

The firms span three main sectors: agriculture, manufacturing, and services. The service sector is the largest, accounting for 73.6%. Within the service sector, approximately 7% of the businesses provide mobile money services or serve as retail financing agents, significantly higher than bank agents (0.62%). This highlights the significant role of mobile money in providing financial services, especially compared to traditional banking.

A feature of the Ghanaian business environment is the high level of informality. Only 8.7% of businesses are formally registered[1], while the remaining operate informally. Among sectors, the service sector demonstrates the highest level of formal registration (10.4%), while the manufacturing sector has the lowest (3.9%) (Table 2). This widespread informality has implications for firms' access to finance, growth opportunities, and the ability to integrate into formal economic systems. Addressing informality could be key to unlocking greater potential for many such enterprises.

The census covered all 16 regions of Ghana. The Greater Accra Region accounts for the highest concentration of firms, representing 23%. Other significant regions included Ashanti (16%), Central (9%), and Eastern (9%). Such regions as North East, Savannah, and Ahafo, have relatively fewer firms, each contributing less than 2% of the total. This regional distribution highlights potential disparities in business density and economic activity across Ghana, which could affect digital payments adoption and usage, and economic development efforts.

Gender representation is notable in the Ghanaians business community, with over 60% of businesses having at least one female owner or one female manager. This is particularly evident in the service and industry sectors, where 64.2% and 63.1% of businesses, respectively, are owned by women, and 62.6% and 63.7% are managed by women. In contrast, the agriculture sector remains male-dominated, with only 32.5% owned by women and 31.6% managed by women. It also has the highest proportion of male-only ownership and management (63.5%), underscoring significant gender disparities.

Notably, businesses with female ownership across all sectors are more likely to have female managers. For instance, 58.9% of businesses in the service sector and 61.3% in the industry sector with female owners also have female managers, compared to just 27.6% in agriculture ( Table 3).

[1] Formal business is defined as registration with any of the institutions: Ghana Revenue Authority, Regiterar General's Department, District Assembly, Environmental Protection Agency.

**Table 1: Summary Statistics of Firms in the IBES 2024 census**

| | Observations | Mean | Std | Min | Max | p95 |
|---|---|---|---|---|---|---|
| Years of business | 1,855,343 | 9.608 | 10.717 | 1.000 | 225.000 | 28.000 |
| Firm Size | | | | | | |
| no. of employees | 1,855,346 | 3.553 | 46.661 | 1 | 50000 | 9 |
| no. of female employees | 1,855,346 | 1.833 | 16.601 | 0 | 15000 | 6170 |
| no. of owners | 1,787,971 | 1.169 | 1.535 | 1 | 99 | 2 |
| no. of female owners | 1,787,964 | 0.663 | 0.934 | 0 | 92 | 1 |
| no. of managers | 1,855,351 | 1.291 | 5.636 | 0 | 4000 | 2 |
| no. female managers | 1,855,349 | 0.720 | 2.652 | 0 | 1400 | 1 |
| Types of ownership | | | | | | |
| State owned | 1,855,401 | 0.031 | 0.174 | 0 | 1 | 0 |
| Private | 1,855,401 | 0.964 | 0.186 | 0 | 1 | 1 |
| Public Private Partnership | 1,855,401 | 0.005 | 0.068 | 0 | 1 | 0 |
| Sector | | | | | | |
| Agriculture | 1,855,187 | 0.026 | 0.160 | 0 | 1 | 0 |
| Manufacturing | 1,855,187 | 0.237 | 0.425 | 0 | 1 | 1 |
| Services | 1,855,187 | 0.736 | 0.441 | 0 | 1 | 1 |
| Business Registration | | | | | | |
| formal | 1,855,841 | 0.087 | 0.282 | 0 | 1 | 1 |
| informal | 1,855,841 | 0.913 | 0.282 | 0 | 1 | 1 |
| Annual Revenue | | | | | | |
| below 10000 | 1,855,343 | 0.699 | 0.459 | 0 | 1 | 1 |
| 10001 - 50000 | 1,855,343 | 0.222 | 0.416 | 0 | 1 | 1 |
| 50001 - 100000 | 1,855,343 | 0.069 | 0.254 | 0 | 1 | 1 |
| over 100000 | 1,855,343 | 0.010 | 0.097 | 0 | 1 | 0 |
| Has female owner | 1,855,841 | 0.631 | 0.482 | 0 | 1 | 1 |
| Has female manager | 1,855,841 | 0.621 | 0.485 | 0 | 1 | 1 |
| Mobile money agent | 1,855,364 | 0.074 | 0.262 | 0 | 1 | 1 |
| Bank agent | 1,855,364 | 0.006 | 0.078 | 0 | 1 | 0 |

**Table 2: Business Sectors and Formality**

| Sector | Formal Business | | Informal Business | | Total | |
|---|---|---|---|---|---|---|
| | number | percent | number | percent | number | percent |
| **Agriculture** | 2,802 | 5.7% | 45,996 | 94.3% | 48,798 | 100% |
| **Manufacturing** | 17,078 | 3.9% | 423,163 | 96.1% | 440,241 | 100% |
| **Service** | 141,535 | 10.4% | 1,224,613 | 89.6% | 1,366,148 | 100% |

*Note*: the percentage is calculated as the shares of each sector.

**Table 3: Business Sectors and Leadership Types**

| | Agriculture | | Manufacturing | | Service | |
|---|---|---|---|---|---|---|
| | number | percent | number | percent | number | percent |
| Has female owner | 15,845 | 32.5% | 277,882 | 63.1% | 876,926 | 64.2% |
| | | | | | | |
| Has female manager | 15,425 | 31.6% | 280,330 | 63.7% | 855,767 | 62.6% |
| | | | | | | |
| Has only male owners x has only male managers | 30,993 | 63.5% | 152,070 | 34.5% | 438,225 | 32.1% |
| | | | | | | |
| Has only male owners x has female managers | 1,960 | 4.0% | 10,289 | 2.3% | 50,997 | 3.7% |
| | | | | | | |
| Has female owners x has only male managers | 2,380 | 4.9% | 7,841 | 1.8% | 72,156 | 5.3% |
| | | | | | | |
| Has female owners x has female managers | 13,465 | 27.6% | 270,041 | 61.3% | 804,770 | 58.9% |

*Note:* the percentage is calculated as the share of each sector.

# 2 Digital Payments Adoption

## *2.1 Summary of Response*

Overall, 37% of businesses accept or use digital payments, making it the most prevalent non-cash payment method – significantly higher than such alternatives as checks or bank transfers. This finding was based on responses to the survey question "*For business transactions, which payment system do you use or accept?*". The widespread usage underscores the growing preference for digital solutions over traditional non-cash methods.

Adoption rates vary considerably by firm size, formality, sector, and revenue (Figure 1). Among small firms employing 6 to 30 people, the adoption rate is the highest, with 48% integrating digital payment methods into their operations. In contrast, micro firms with fewer than 5 employees show the lowest adoption rate (36%).

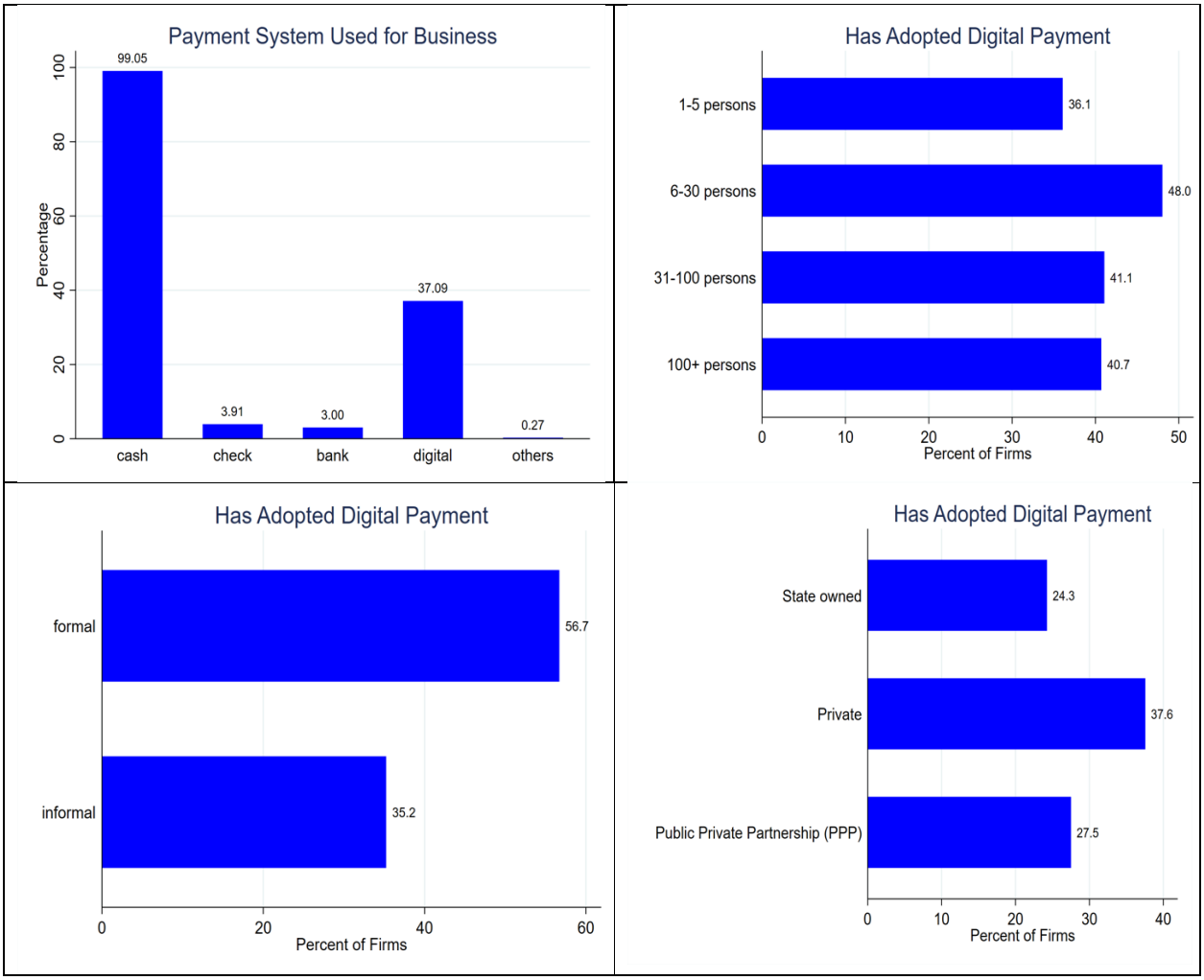
Formal businesses show higher rates of digital payments adoption compared to informal businesses. Specifically, 56.7% of formally-registered businesses have adopted digital payments, while 35.2% of informal businesses have. This suggests formal registration potentially facilitates better access to digital financial infrastructure and incentives,

encouraging the adoption of digital payment methods. The divide between formal and informal businesses highlights the importance of policies that support the formalization of enterprises, as formal firms are better positioned to leverage digital financial services.

The service sector exhibits the highest rate of digital payment usage, with 38.3% of businesses integrating digital solutions. The widespread adoption of services may be due to the higher demand for flexible and convenient payment methods in service-oriented transactions. In contrast, the agricultural sector lags behind, with 22.4% of firms using digital payments.

Adoption rates increase as firm revenue grows. Among businesses generating annual revenues of more than GH₵20,000,000 in 2022, 71% report using digital payment solutions. The high rate suggests larger and more profitable firms are better able to adopt digital tools, potentially due to greater access to capital, resources, and digital infrastructure. On the other hand, firms generating less than GH₵10,000 annually exhibit a substantial adoption gap, with 31% utilizing digital payment methods.

*Figure 1: Digital Payments Adoption by Firm Characteristics*



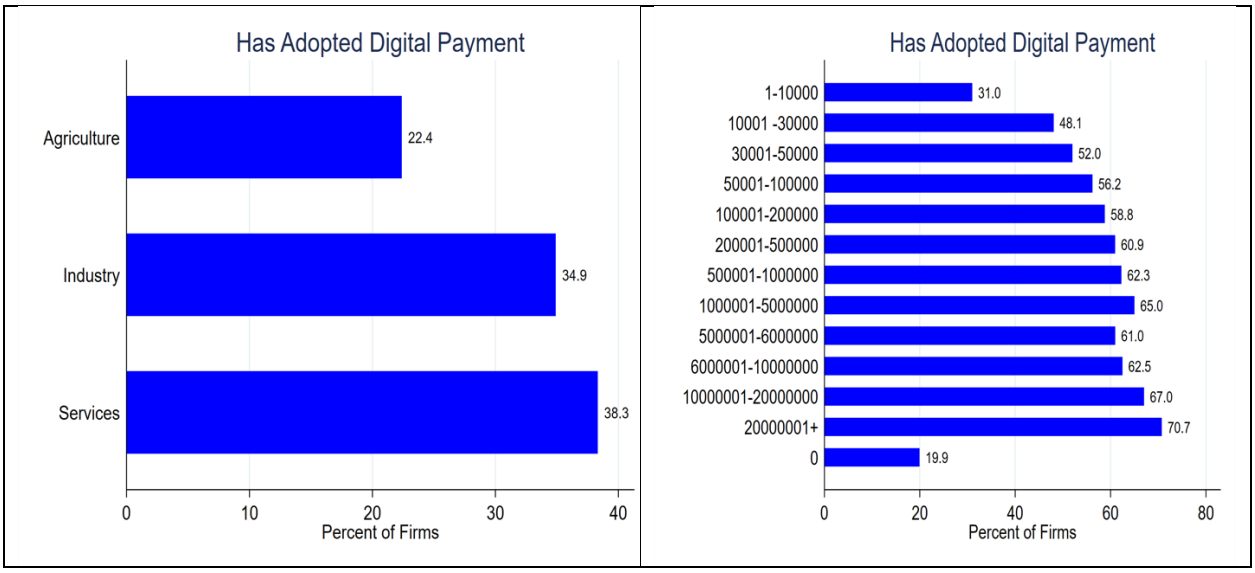
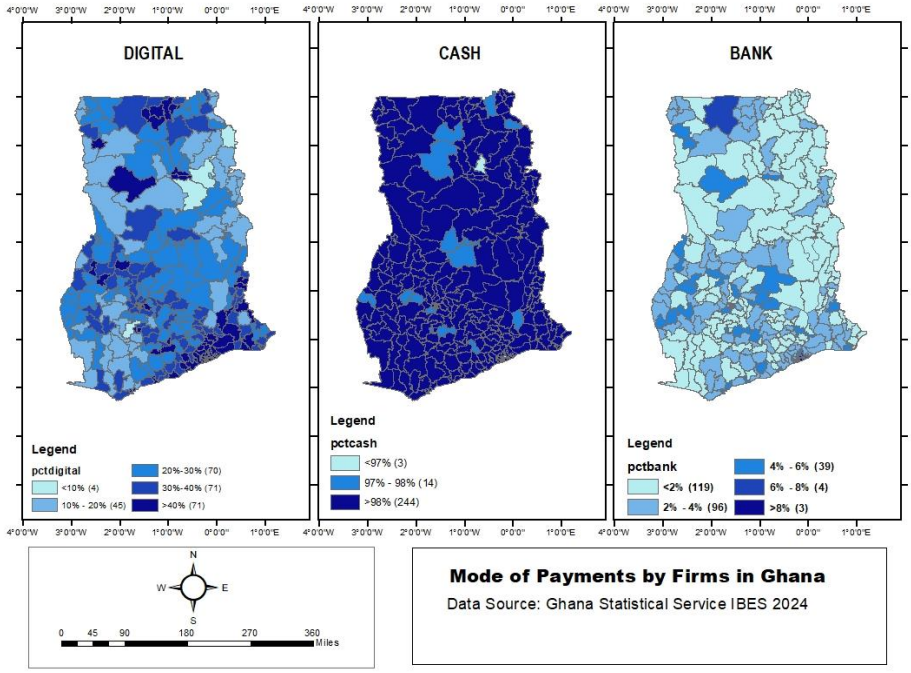



Figure 2 shows the district distribution of modes of payment by firms in Ghana. Most firms in all the 261 districts of Ghana use more cash payment for transactions compared to the other modes of payment. Only three districts recorded the least percentage of cash payments, however, these were above 95%. Ayawaso West (Greater Accra Region)

*Figure 2: Distribution of Mode of Payment by Firms*



recorded 96.40% of firms using cash payments, Korle-Klottey (Greater Accra Region) recorded 96.73%, and Nanton (Northern Region) recorded 96.91%. The maps also show that, compared to bank payments, more firms have adopted digital payments. Only four districts showed less than 10% of firms using digital payments. The Mion District (Northern Region) recorded 4.97% of digital payment use while most of the highest digital use is clustered around the Greater Accra Region. The result indicated businesses have embraced digital payments compared to traditional bank payments.

Considering firms that use digital payments, the adoption of personal mobile money payments outpaces merchant or MoMoPay accounts. In almost every district, more than 80% of firms adopting digital payments use personal MoMo payment, and a few districts show a little above 40% of the adoption of merchant payments (Figure 3). Almost all the districts hosting regional capitals show higher levels of merchant payment (above 20%) except Krachi East District (Oti Region) and the New Juabeng South District (Eastern Region) that record 19.01% and 16.82% merchant payments, respectively.

*Figure 3: Types of Digital Payments by Firms*

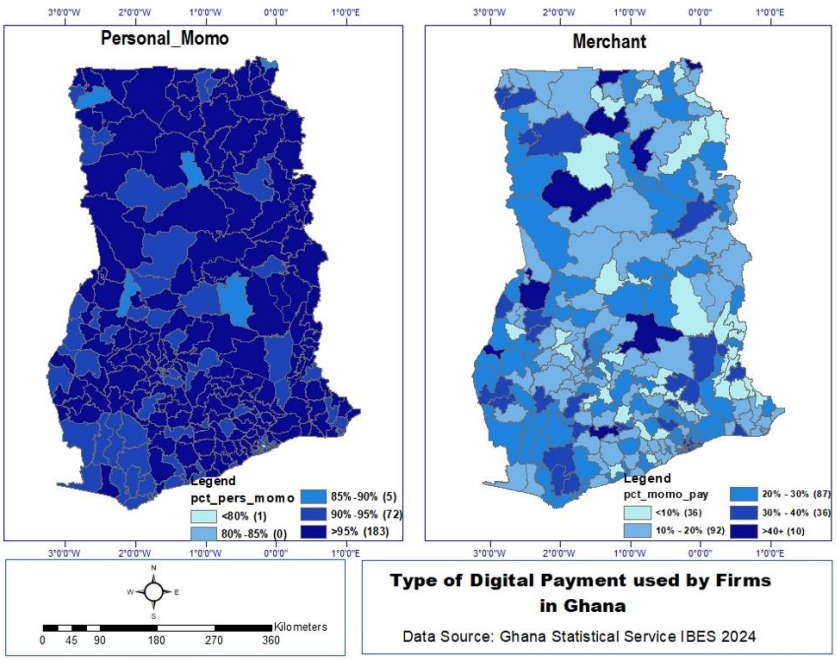



Figure 4 illustrates the distribution of formal and informal businesses across districts in Ghana. The map reveals that over 90% of businesses operate informally, indicating that most firms, particularly in northern Ghana, are unregistered. These results highlight the North-South divide in Ghana, where a higher proportion of businesses in the south are registered compared to those in the north.

*Figure 4: Distribution of formal and Informal Businesses in Ghana*

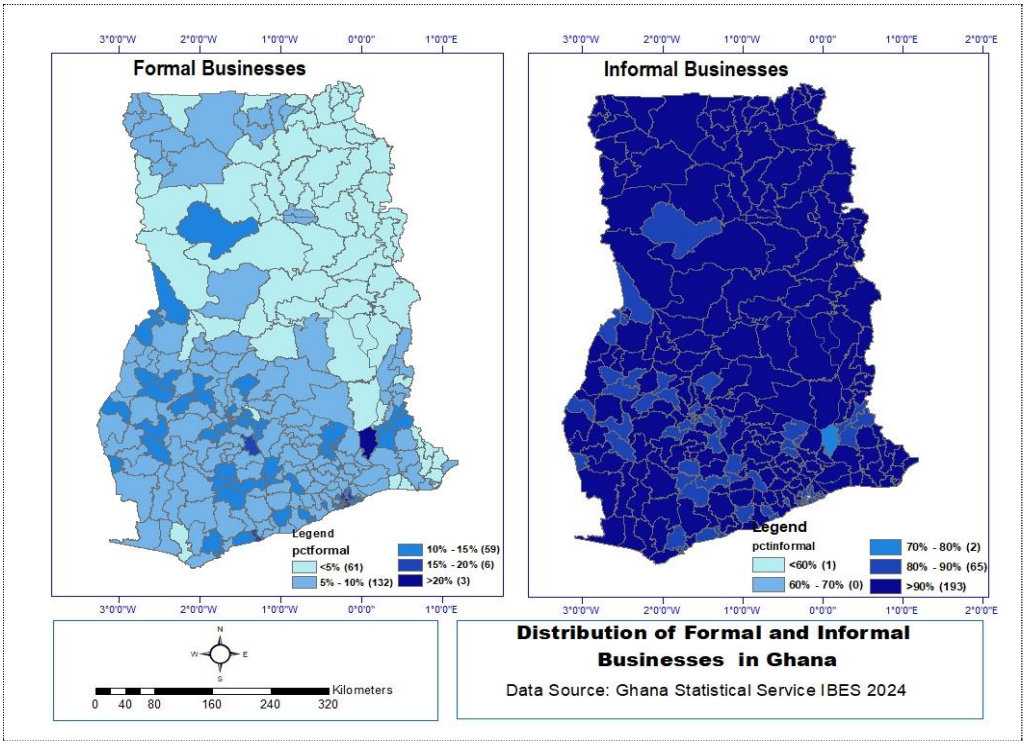
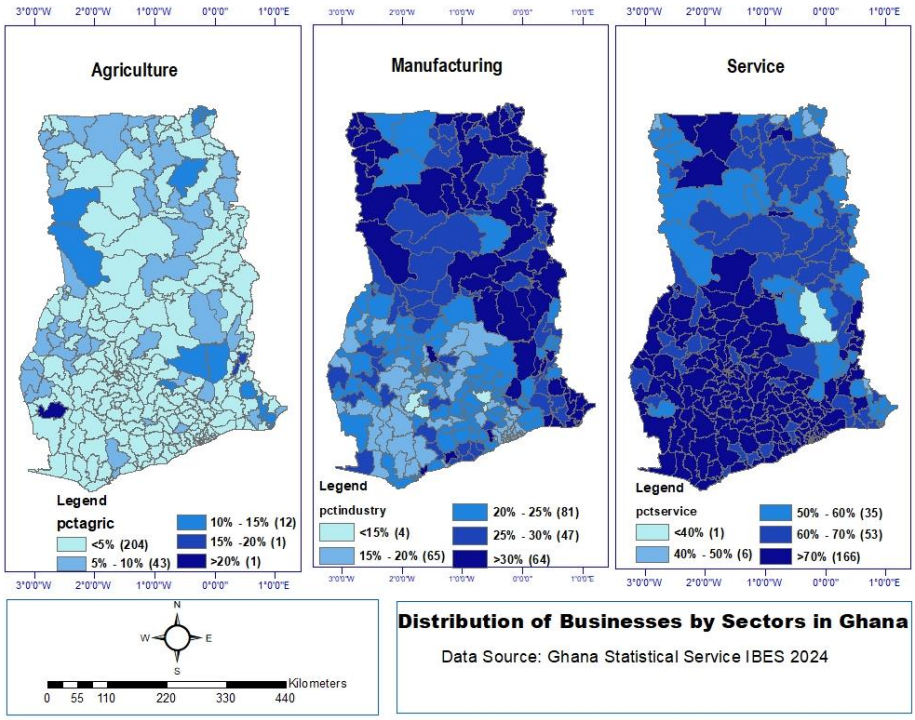



Figure 5 illustrates the distribution of firms by sector. The map shows the service sector dominates both the manufacturing and agricultural sectors.

*Figure 5: Distribution of Businesses by Sectors in Ghana*



The results indicate that only a small number of businesses operate in the agricultural sector, suggesting that most farmers in Ghana engage in subsistence farming rather than commercial agriculture, which may prevent their classification as businesses. Additionally, the results highlight a North-South divide, with more manufacturing businesses concentrated in northern Ghana while the service sector is more prevalent in the south.

### *2.2 Spatial Analysis on Digital Payments Adoption*

Two measures are used to analyze digital payments adoption: a district-level rate, calculated as the number of businesses adopting digital payments in a district divided by the total number of firms in that district, and a global adoption measure, which divides the number of adopting businesses in a district by the total number of businesses nationwide. These measures provide a basis for both local and global policy recommendations.

Figure 6 shows the adoption of digital payments by businesses in Ghana. The rates are based on the total population of businesses in each district. The second map shows the variations (standard deviations) within the districts. Forty-six districts showed 20% or less adoption rates, while 25 districts recorded rates above 50%. One hundred and fifty-six districts recorded higher variability between 0.45 and 0.50, while 4 districts recorded variability between 0.22 and 0.30. This indicates variations in digital payments adoption in districts.

*Figure 6: Digital Payments Adoption Rates in Ghana*

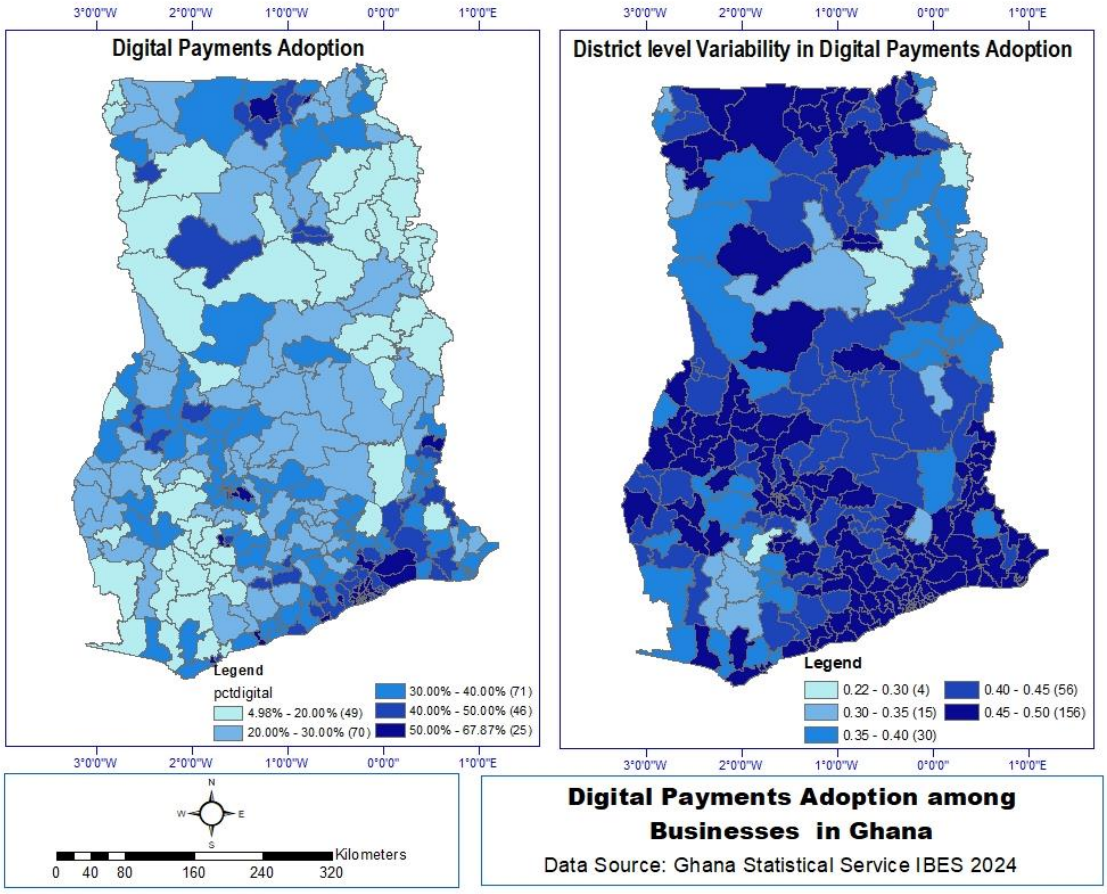



Figure 7 shows a choropleth map of the distribution of digital payments adoption. The map shows proportional adoption rates at the district level as a fraction of the total number of businesses in the whole country, thus, measuring the global definition for digital payments adoption. Higher proportions are observed in regional capitals and in districts located in the Greater Accra Region.

Pockets of higher proportions of adoption are observed in the south compared to the north. For each district, spatial autocorrelation was tested using both local and global rates of adoption. In this analysis, positive and negative spatial autocorrelations are observed. A positive spatial autocorrelation (represented by "high-high" and "low-low") indicates similarities in a district and its immediate neighbors or clustering of high or low adopters of digital payments. On the other hand, a negative spatial autocorrelation (represented by "high-low" and "low-high") indicates dissimilarities in districts. The analysis further used the Global Moran's I statistic to measure the existence and extent of global clustering.

*Figure 7: Digital Payments Adoption based on all Businesses in the Country*

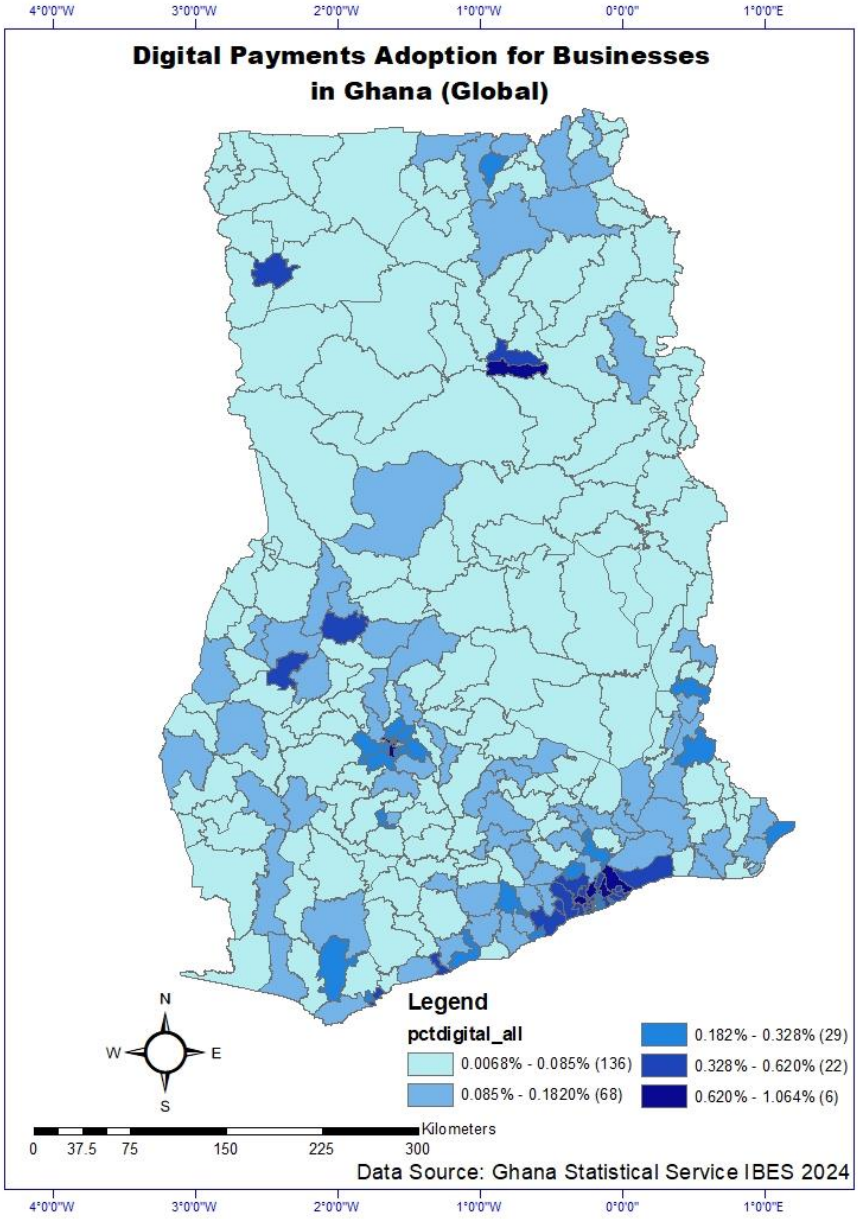
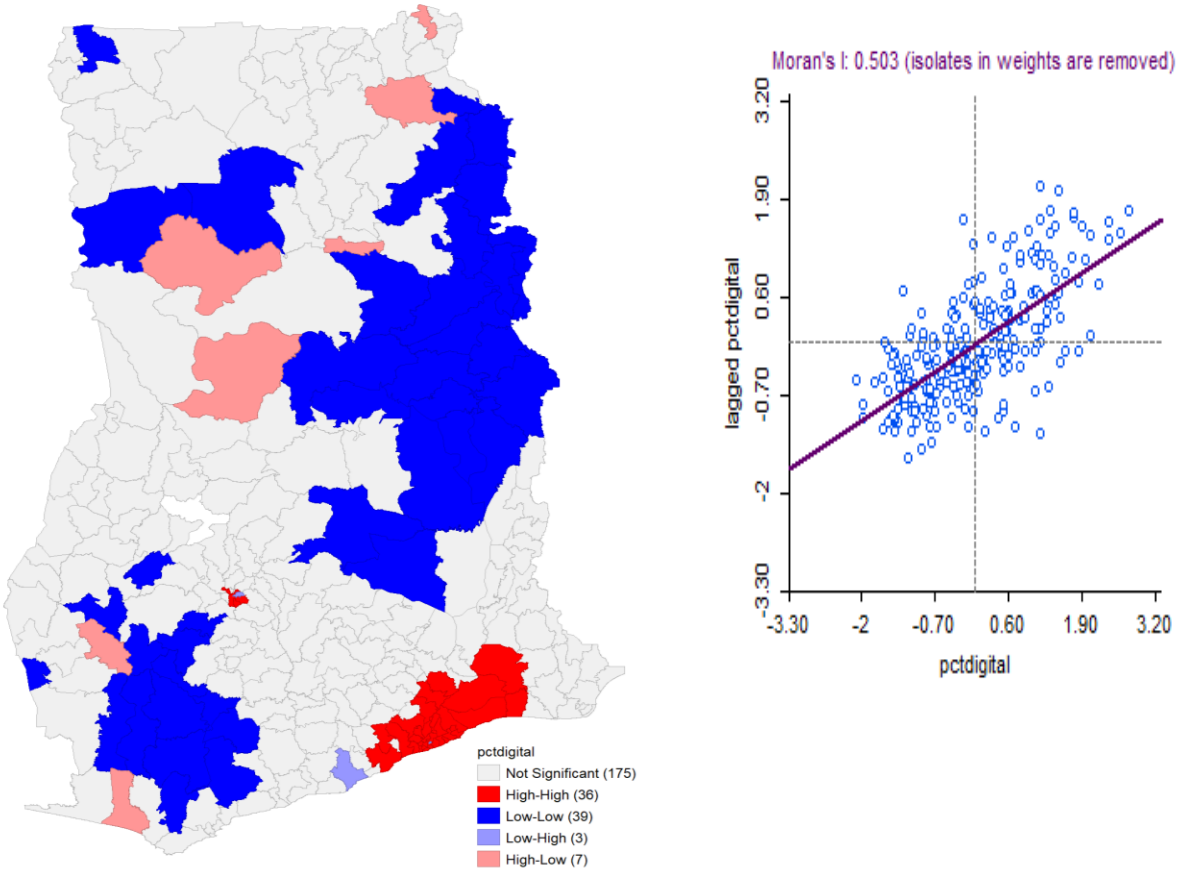



Figure 8 presents the local indicator for the spatial association for district-level digital payments adoption. The map shows 36 districts with high adoption rates, 3 of which are in the Ashanti Region (Kumasi Metropolitan Assembly, Oforikrom, and Asokwa), 28 in the Greater Accra Region and 5 others that share boundaries with the Greater Accra Region or are in close proximity to the region, including Akuapim North, Akuapim South, and Gomoa East.

*Figure 8: District-level LISA Map for Digital Payments Adoption in Ghana*

**Local Indicators of Spatial Association (LISA) Maps for Digital Payments Adoption in Ghana (District Level)**

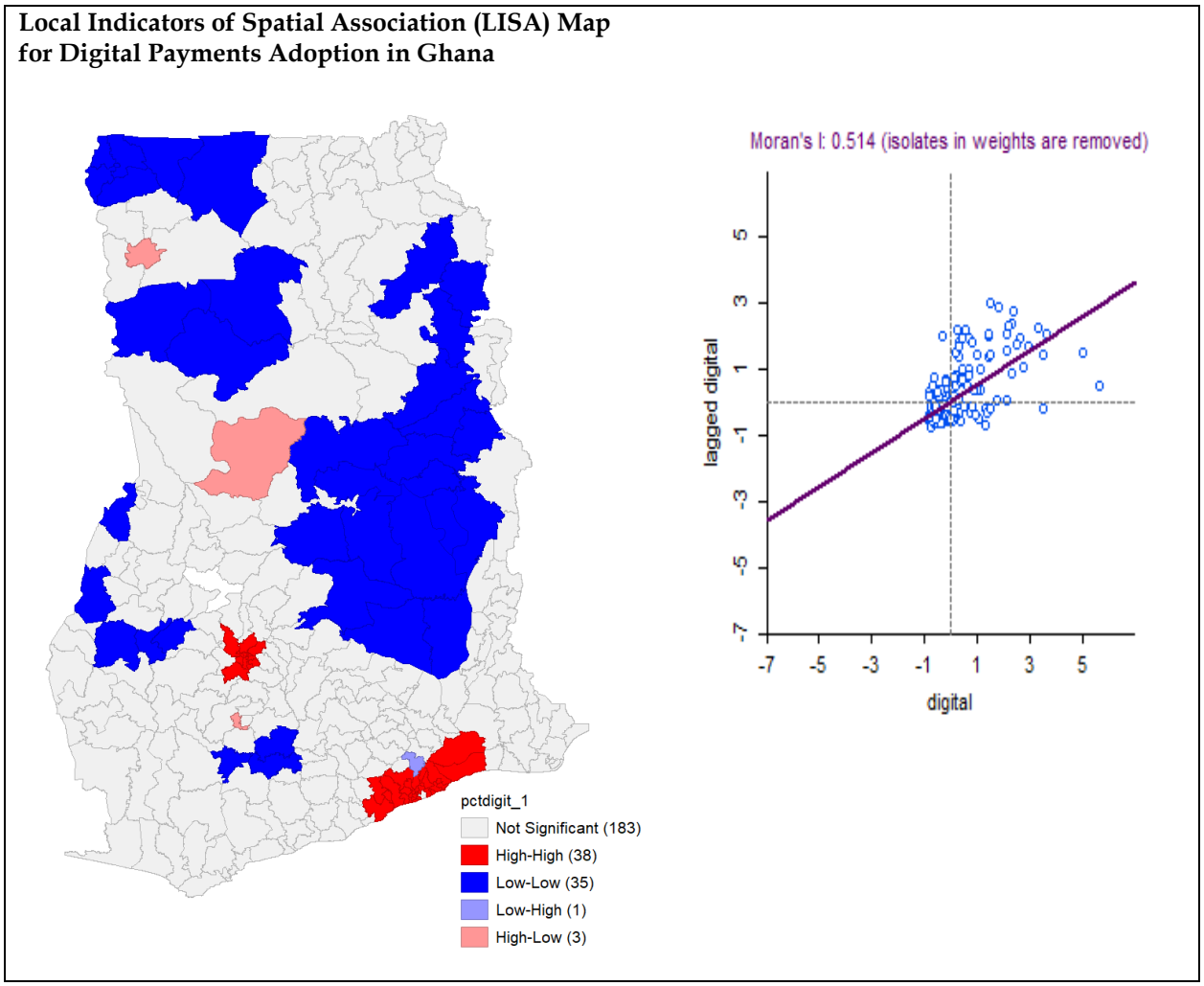



Low rates are clustered in the south-western and eastern parts of the country. These represent a positive spatial autocorrelation, suggesting a high market integration or shared influence across districts that create spillover effects. Negative spatial autocorrelation (high adoption surrounded by low adoption) is observed in 7 districts, most of which host regional capitals, including Bawku Municipal, Kintampo North, Sefwi Wiawso, Tamale Municipal, and West Gonja. This indicates the dominance of economic activities in these areas and an urban-rural digital divide. These negative autocorrelations clearly show that these markets are poorly integrated, or they may be more specialized.

The Global Moran I is 0.5, indicating a positive spatial autocorrelation in digital payments adoption in Ghana. Both global and local results indicate there are spatial effects in digital payments adoption.

These results are consistent with the LISA map for the global definition for adoption, as shown in Figure 9. The map shows 38 districts with high adoption, and 39 with low adoption rates as their neighbors. The Global Moran I is 0.51, also indicating a positive spatial autocorrelation in digital payments adoption in Ghana.

*Figure 9: LISA Map for Digital Adoption based on all Businesses in the Country*




Spatial distribution and variation of digital merchant payments adoption by businesses were analyzed, using the local and global definitions of adoption. Figure 1 shows district-level rates of adoption based on the total number of firms in each district. The district merchant adoption ranges from 0.51% to 33.42%, indicating low adoption across the country. Rates of adoption, using all businesses in the country, show about 120 districts with rates between 0.001% and 0.014% (Figure 1).

*Figure 10: Merchant Adoption across Districts*

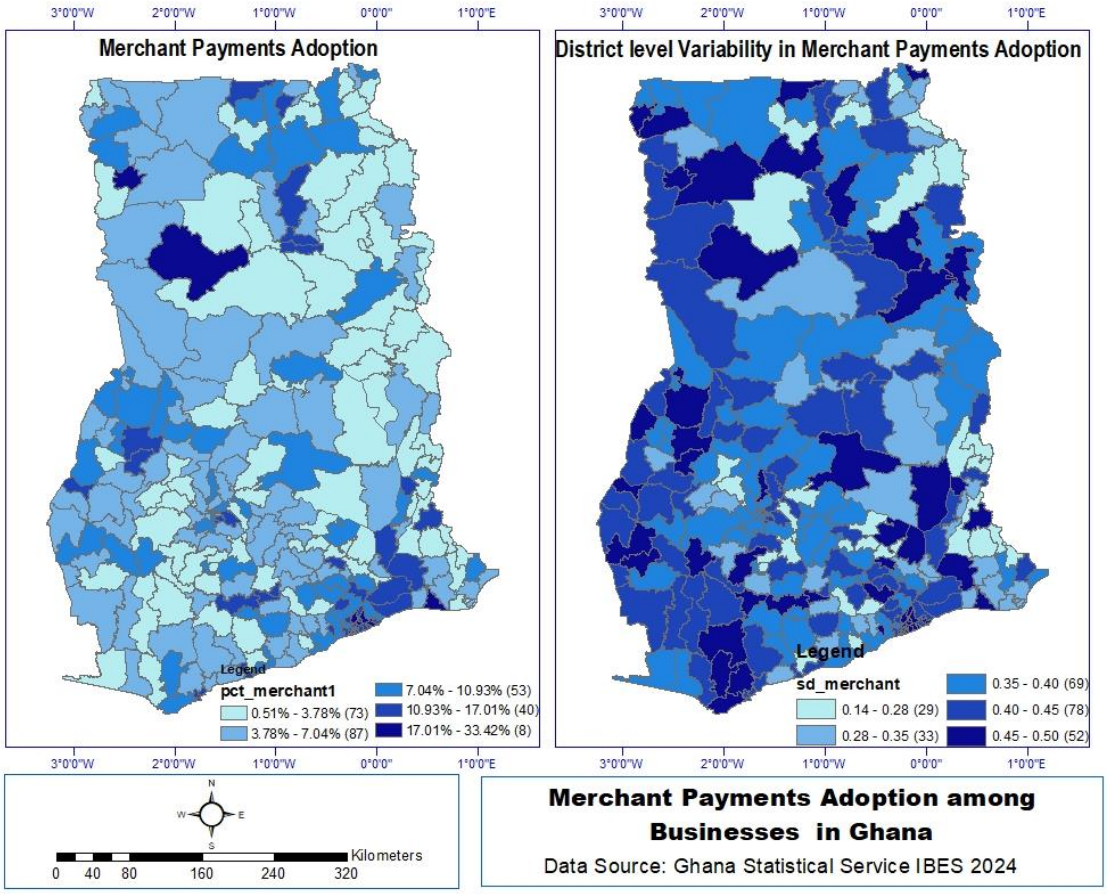
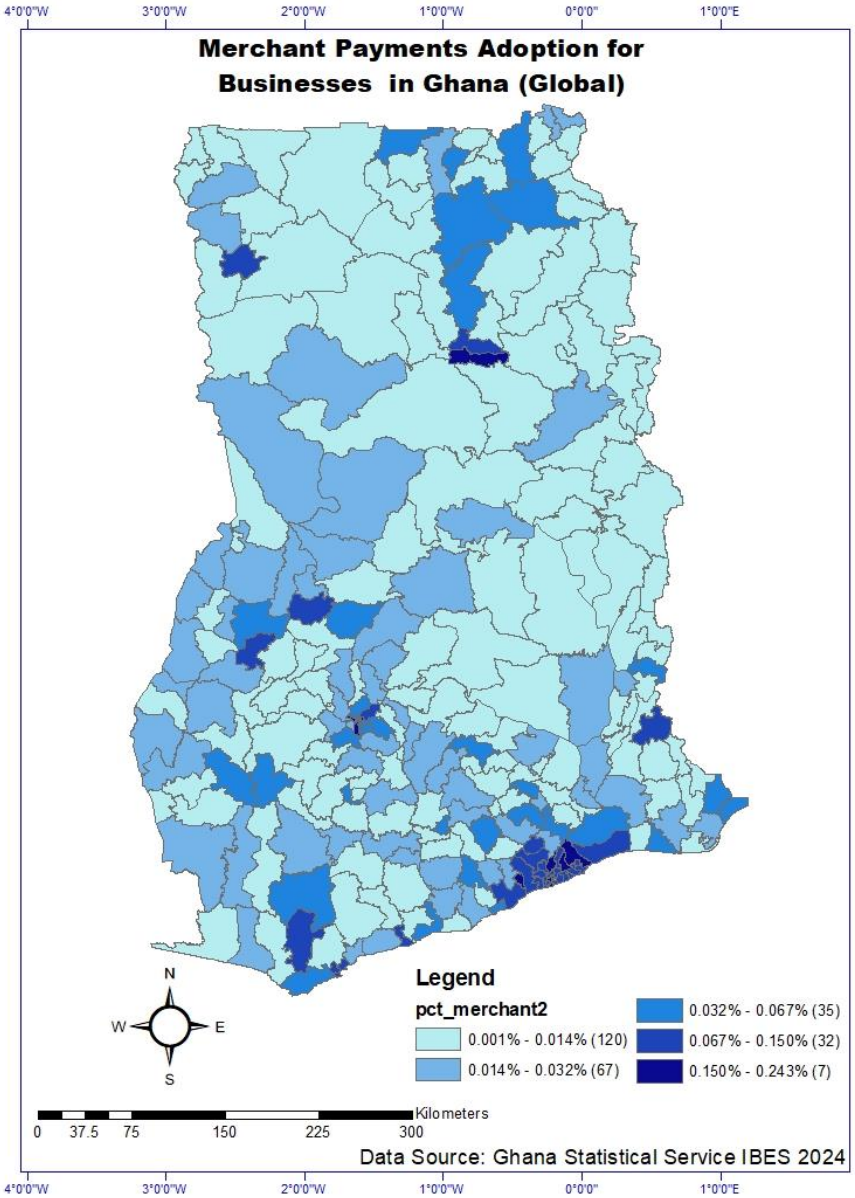


*Figure 11: Merchant Adoption based on all Businesses in the Country*




The authors examined local indicators for spatial association for both merchant and personal payments adoptions and observed high adoption clustered in the Greater Accra Region (Figures 12 and 13). The results show higher levels of adoption in the region compared to the other parts of the country. A lower Global Moran I (0.36) was observed with the district-based adoption compared to the global definition for adoption.

Considering overall variability, the results of the spatial analysis on the digital merchant payments adoption are consistent with that of digital payments adoption, showing similar patterns and clusters in the Greater Accra Region. However, unlike the digital payments adoption, fewer districts with higher merchant adoption are observed.

*Figure 12: LISA Map for District-level Merchant Adoption*

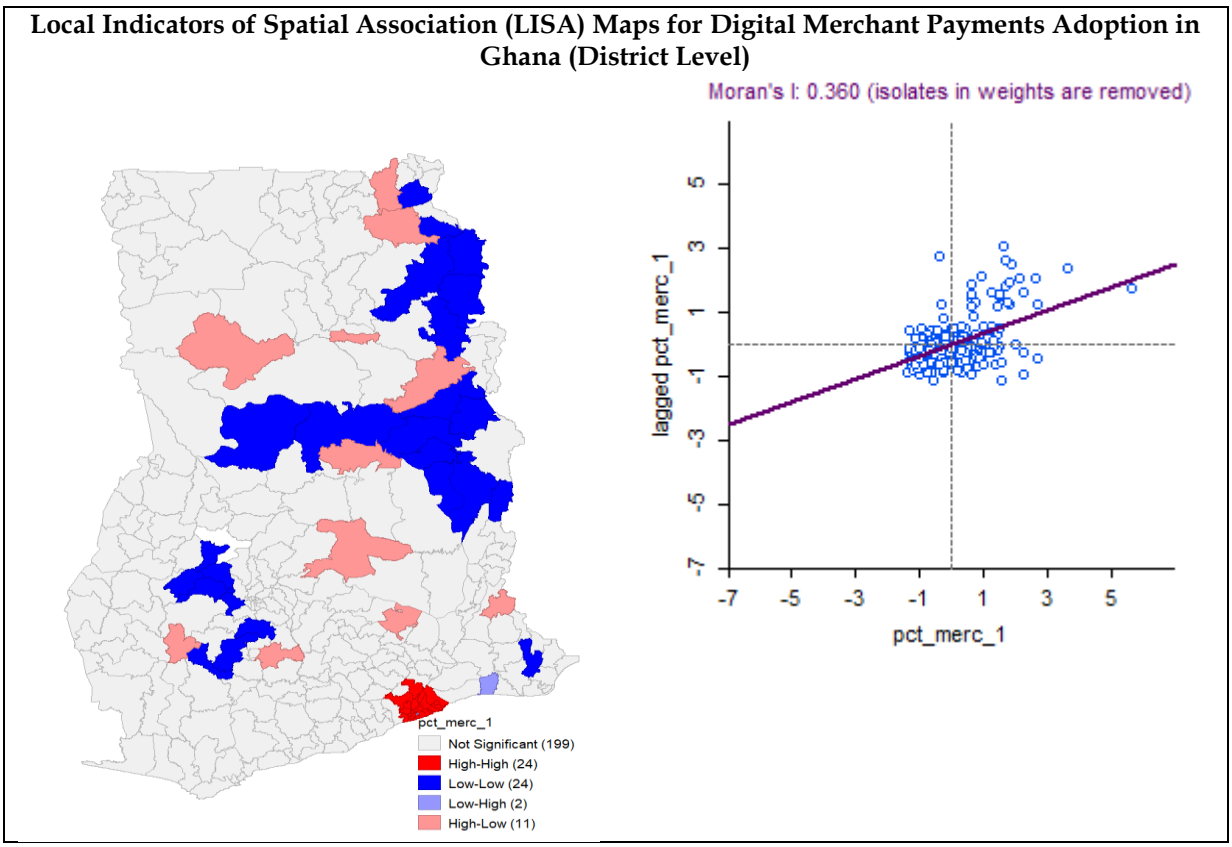
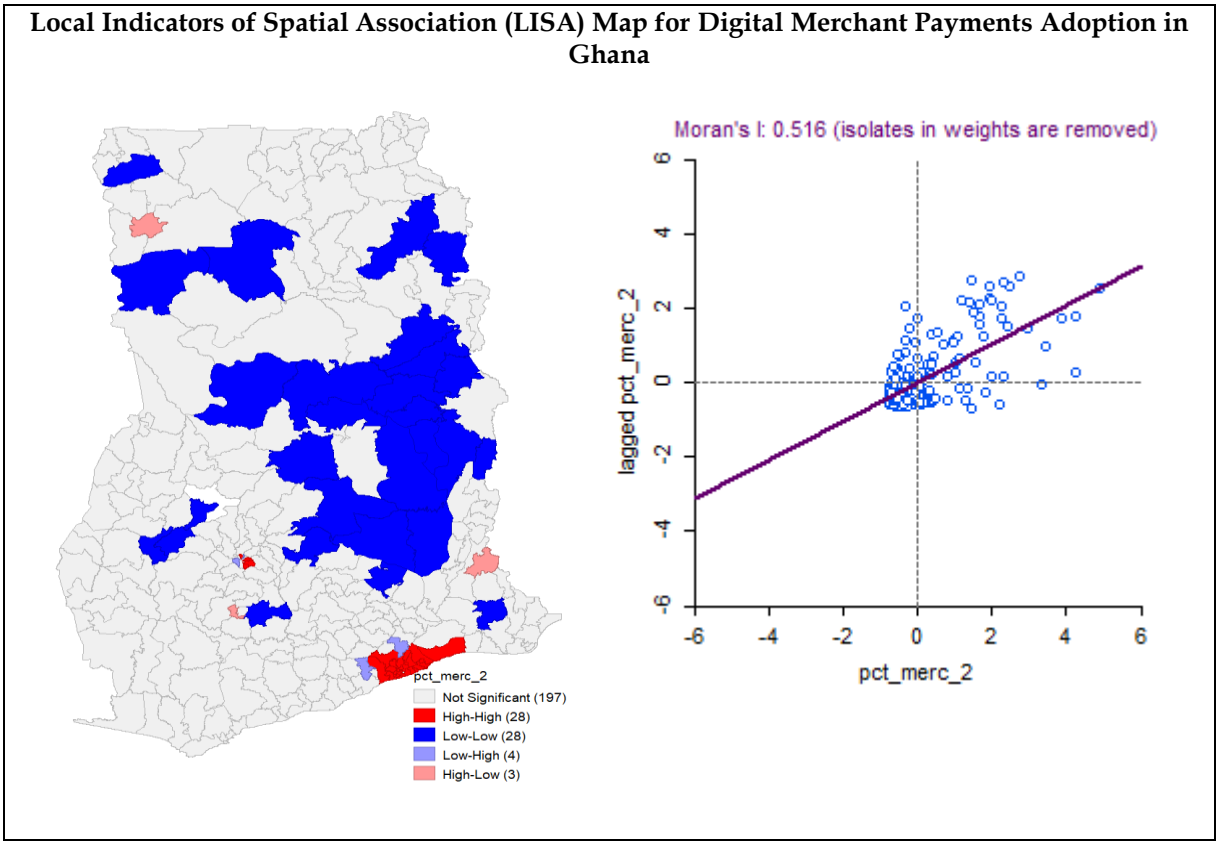


*Figure 13: LISA Map for Merchant Adoption based on all Businesses*




## 2.3 Regression Analysis with Firm Characteristics

The analysis focused on different types of digital payments adoption, including overall adoption, adoption of merchant account, and adoption of personal account.

$$y_i = \alpha + \beta_1 Firm\ Size_i + \beta_2 Sector_i + \beta_3 Formal_i + \beta_4 Female\ Ownership_i + \beta_5 Firm\ Revenue_i + \gamma District_i + \epsilon_i \quad (1)$$

Table 4 shows the correlation between business characteristics and digital payments adoption, based on results from an OLS regression with district-fixed effects as in Equation ( 1). The dependent variable $y_i$ is a dummy indicator for three types of digital payments adoption: digital payment in general (column 1), adoption of merchant account (column 2), and adoption of personal account (column 3). Firm characteristics, such as firm size, sector, formality, female ownership, and revenue are included along with district-fixed effects, and the standard errors are clustered at the district level.

The analysis indicates micro and small firms, employing fewer than 30 persons, are the most likely to adopt digital payments in general compared to larger firms with more than 100 employees. However, regarding merchant accounts, these smaller firms are less likely to adopt, by 6 to 9 percentage points. The requirement for a business certificate to register

a merchant account potentially presents a barrier for smaller firms, consistent with the findings on formality.

Formal firms are more likely to adopt digital payments, with an increase of 10 percentage points for overall adoption and 16 percentage points for merchant-specific purposes. This suggests formal registration provides better access to the infrastructure or incentives needed for digital payments adoption, especially for business purposes.

**Table 4: Digital Payments Adoptions and Business Characteristics**

| | (1) | (2) | (3) |
|---|---|---|---|
| | Digital (0/1) | Digital merchant (0/1) | Digital personal (0/1) |
| Firm Size | | | |
| Micro 1-5 persons | 0.082*** | -0.093*** | 0.198*** |
| | (0.009) | (0.012) | (0.013) |
| Small 6-30 persons | 0.124*** | -0.067*** | 0.165*** |
| | (0.009) | (0.012) | (0.012) |
| Medium 31-100 persons | 0.014 | -0.015 | 0.077*** |
| | (0.010) | (0.013) | (0.011) |
| Large over 100 persons | 0.000 | 0.000 | 0.000 |
| | (.) | (.) | (.) |
| Sector | | | |
| Agriculture | 0.408*** | 0.439*** | 0.671*** |
| | (0.015) | (0.017) | (0.014) |
| Manufacturing | 0.519*** | 0.448*** | 0.667*** |
| | (0.014) | (0.014) | (0.014) |
| Services | 0.522*** | 0.494*** | 0.648*** |
| | (0.014) | (0.015) | (0.014) |
| Formal | 0.109*** | 0.162*** | -0.087*** |
| | (0.005) | (0.006) | (0.004) |
| Has female owners | -0.072*** | -0.037*** | 0.007*** |
| | (0.003) | (0.002) | (0.001) |
| Revenue | | | |
| below 10000 | -0.247*** | -0.178*** | 0.094*** |
| | (0.012) | (0.012) | (0.006) |
| 10001 - 50000 | -0.093*** | -0.148*** | 0.086*** |
| | (0.012) | (0.011) | (0.006) |
| 50001 - 100000 | -0.024** | -0.103*** | 0.065*** |
| | (0.010) | (0.009) | (0.005) |
| over 100000 | 0.000 | 0.000 | 0.000 |
| | (.) | (.) | (.) |
| R-squared | 0.451 | 0.289 | 0.957 |
| Observations | 1,855,163 | 688,065 | 688,065 |
| Mean of Outcome | 0.371 | 0.231 | 0.954 |

*Notes:* The adoption of merchant and personal accounts is conditional on the overall adoption of digital payments, which results in a smaller number of observations for regressions in columns 2 and 3. The high R-squared value for the personal account regressions (column 3) is because over 90% of firms have adopted personal digital payment accounts, leading to limited variations in the outcome variable. Standard errors in parentheses * p<0.10, ** p<0.05, *** p<0.01

Firms in the services sector are more likely to adopt digital payments compared to those in agriculture or manufacturing. This trend holds across all types of adoption—overall, merchant, and personal use—indicating the service-oriented nature of these firms may align well with the use of digital payment systems. Firms in agriculture and manufacturing also show positive associations with digital adoption, but the effect is most pronounced in the services sector.

Firms with female ownership are 7 percentage points less likely to adopt digital payments overall and 3 percentage points less likely for merchant account. However, for personal account, female ownership has a slight positive association with adoption, suggesting female owners may find convenience in using personal digital payment accounts for business activities.

Firms with lower revenues are generally less likely to adopt digital payments, which points to financial constraints as a barrier to adoption.

The regression analysis underscores the importance of firm characteristics in determining digital payments adoption among firms in Ghana. Larger firms, those in the services sector, and formally-registered enterprises are more likely to adopt digital payments, while smaller, informal firms, and those with lower revenues face barriers. Female-owned firms are generally less likely to adopt digital payments, highlighting the need for targeted support to overcome gender-specific barriers. These findings suggest that policies aimed at supporting smaller firms, informal businesses, and female entrepreneurs could help expand digital payments adoption and drive broader economic inclusion across the country.

### *2.4 Machine Learning Model to Select the Most Important Predictors*

To identify the most important predictors of digital payments adoption, we employed a machine learning algorithm – Least Absolute Shrinkage and Selection Operator (LASSO). LASSO is particularly useful in this context for handling high-dimensional datasets that are potential predictors, as it performs both variable selection and regularization. LASSO regression aims to shrink coefficients of less important variables to zero through regularization, and the non-zero coefficients that remain are the features that LASSO identifies as most relevant in explaining the relationship between the independent variables and the dependent variable.

The LASSO results for general digital payments adoption (Figure ) indicate revenue and formality are key factors that are strongly correlated with adoption, which support earlier findings from the OLS regression analysis. Firms with lower revenue, specifically those earning less than GHS₵10,000, are less likely to adopt digital payments. Formal registration of businesses emerges as a significant positive factor. Furthermore, firms located in the Greater Accra Region are more likely to adopt digital payments, which points to regional disparities in technology access and infrastructure. Female ownership appears to have a slight negative effect on digital payments adoption, indicating potential

gender-specific barriers that limit the uptake of digital payment technologies among female-owned firms.

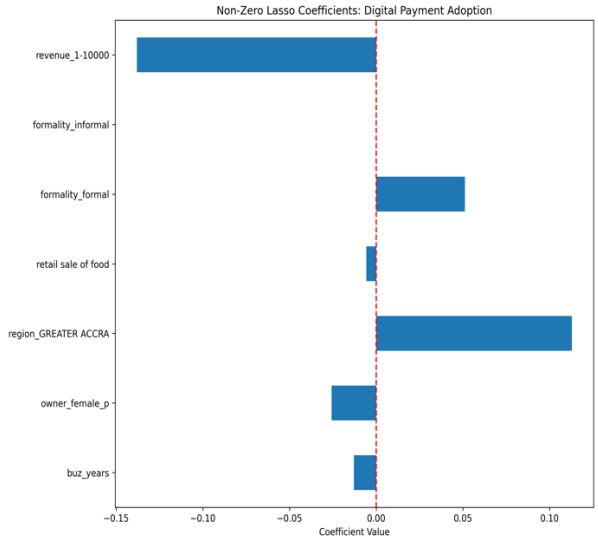



*Figure 14: LASSO Results for Digital Adoption*

The LASSO results for merchant account adoption (Figure ) show formality is the most significant predictor. Formal firms are substantially more likely to adopt merchant accounts, likely due to documentation requirements, such as a business certificate. This finding underscores the importance of regulatory compliance and formalization in facilitating access to business-specific financial tools. Another important predictor is the use of other monetary services, including mobile money. Firms that are familiar with digital financial services are more likely to adopt merchant accounts, suggesting previous exposure to such tools can ease the adoption of additional services. Similar to general digital adoption, lower revenue is associated with a decreased likelihood of adopting merchant accounts. Female ownership is negatively associated with merchant account adoption, pointing to additional challenges faced by female-owned firms in adopting formal financial tools.

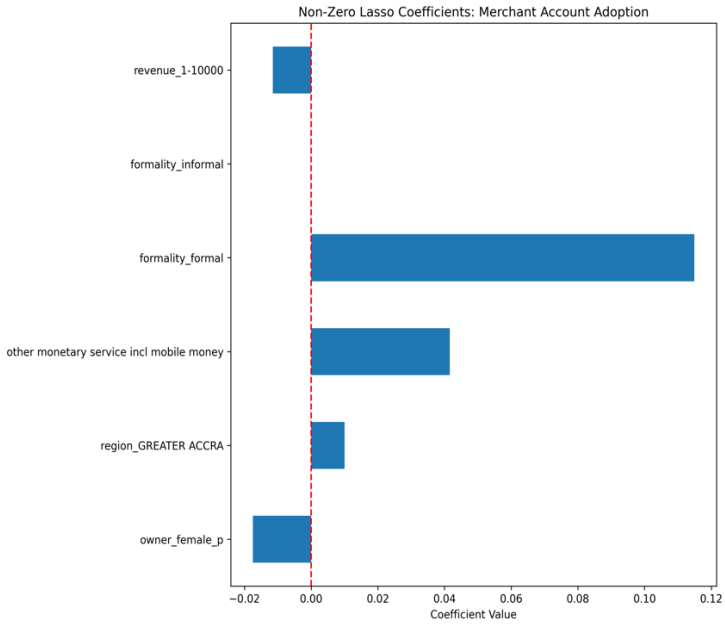



*Figure 15: LASSO Results for Digital Merchant Adoption*

## 2.5 Types of Digital Payments Technology

Businesses were asked to report the specific types of digital payments technology they use, including personal mobile money, dedicated business mobile money account (such as MTN MoMoPay or Vodafone Pay), QR codes, POS devices, digital payment platforms, bank cards, and internet and mobile banking.

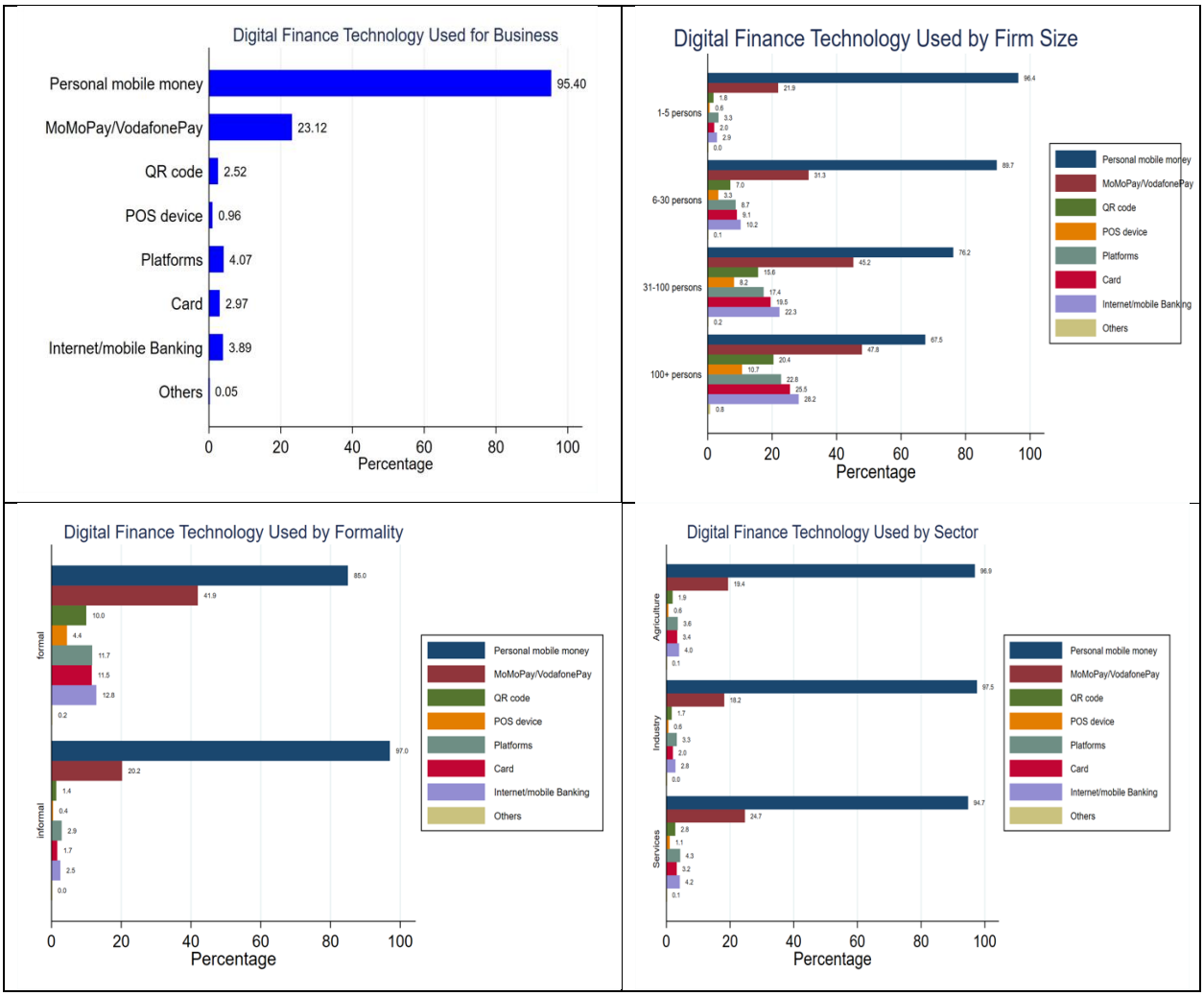
The survey results (Figure ) revealed personal mobile money is by far the most widely used technology, with 95% of businesses relying on it. Only 23% of businesses have dedicated business mobile money accounts. The use of personal mobile money accounts is particularly dominant among micro firms (1-5 employees), with 96.4% adopting this option. Even as firm size increases, personal mobile money remains highly prevalent; 67.5% of large firms (with over 100 employees) continue to use personal mobile money accounts. This suggests that, despite the advantages of having a business-specific account, many firms find personal mobile money accounts practical and accessible option, even on larger scales.

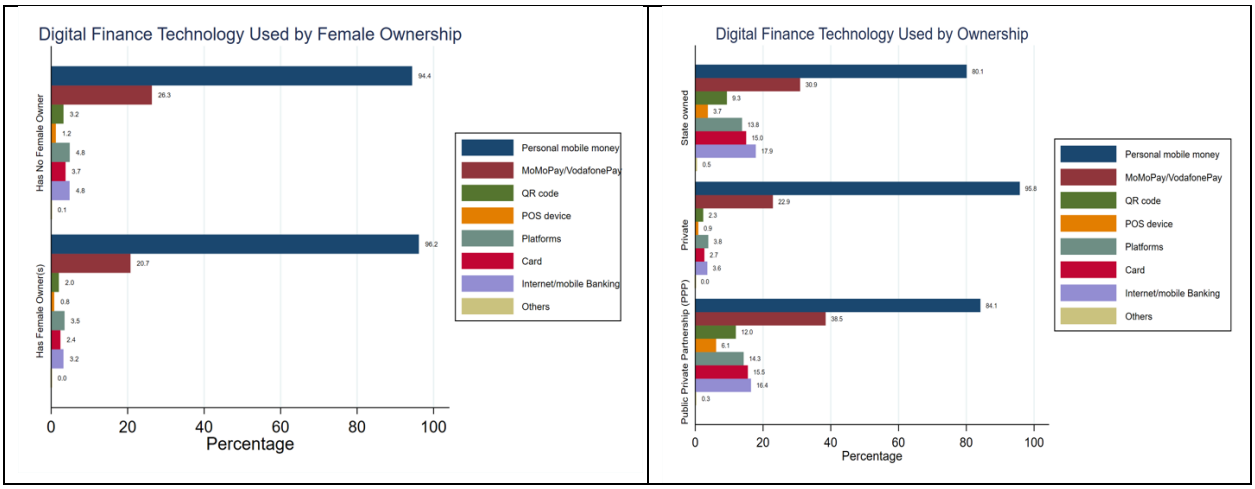
The adoption of business mobile money accounts, such as MoMoPay or VodafonePay, varies across firm sizes. Medium-sized firms (31-100 employees) and large firms (over 100 employees) report higher adoption rates, at 44.9% and 48.8%, respectively. This suggests that as firms grow, they may be more inclined to formalize their financial transactions by adopting business-specific digital payments tools, which could offer such benefits as improved record-keeping and better integration with other business systems.

The utilization of various digital payments technologies, such as QR codes, POS devices, platforms, cards, and internet/mobile banking, increases with firm size. This trend suggests larger firms, which typically handle more complex transactions, are more likely to adopt a range of digital payment technologies to meet their needs. In contrast, micro firms predominantly use personal mobile money and MoMoPay/VodafonePay, which limit access to other forms of digital payments, highlighting a technology gap between micro and larger firms.

Overall, Figure 16 highlights a clear trend that personal mobile money solutions dominate in smaller firms due to perhaps the ease of use and accessibility, while larger firms deploy a broader range of digital payment technologies, likely reflecting their more complex financial operations and needs.

*Figure 16: Digital Payments Technology Types*






# Correlation between Personal Mobile Money and Merchant Account Adoption

Table 5 presents the effects of personal account adoption on merchant account adoption with and without controlling for other business characteristics. The findings indicate the adoption of a personal account reduces the likelihood of merchant account adoption by 58 percentage points, even after accounting for such factors as firm size, revenue, sector, and formality. This suggests firms with personal accounts may be substituting these accounts for dedicated merchant accounts, possibly due to the convenience or perceived redundancy in maintaining both types of accounts. This result reinforces the notion that the use of personal accounts can serve as a barrier to adopting formal business accounts, even when other business factors are considered. As seen in Figure  (Section 2.5), 67.5% of firms with more than 100 people still use personal mobile money accounts.

**Table 5: Correlation between Personal and Merchant Account Adoptions**

| | (1) | (2) |
|---|---|---|
| | digital merchant | digital merchant |
| digital personal | -0.575*** | -0.587*** |
| | (0.061) | (0.011) |
| R-squared | 0.326 | 0.350 |
| Observations | 688,159 | 688,065 |
| Mean of Outcome | 0.231 | 0.231 |
| Controls | No | Yes |

*Note*: Control variables include firm size, sectors, revenue categories, and owner's gender. Standard errors in parentheses * p<0.10, ** p<0.05, *** p<0.01

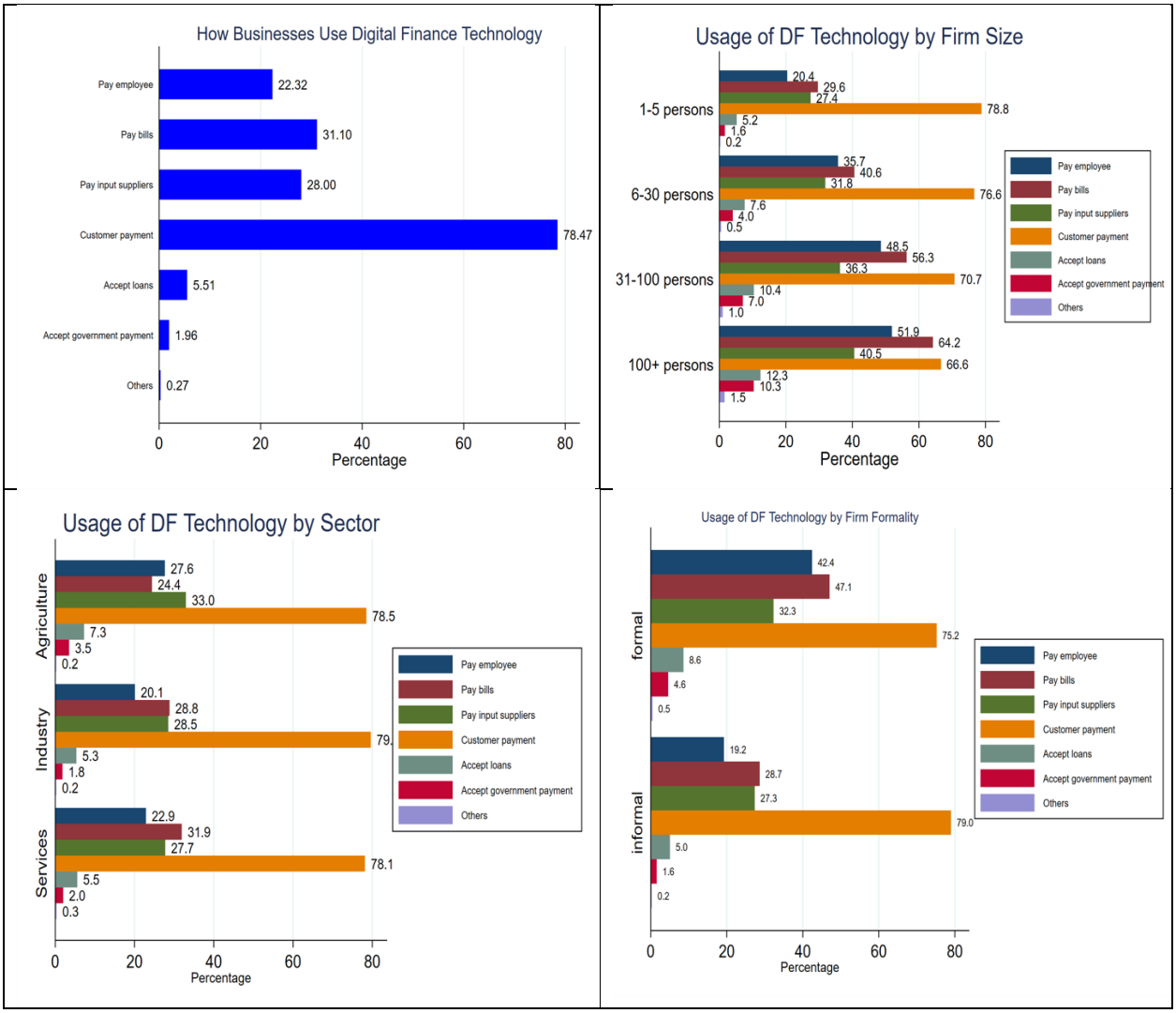
# 3 Digital Payments Use

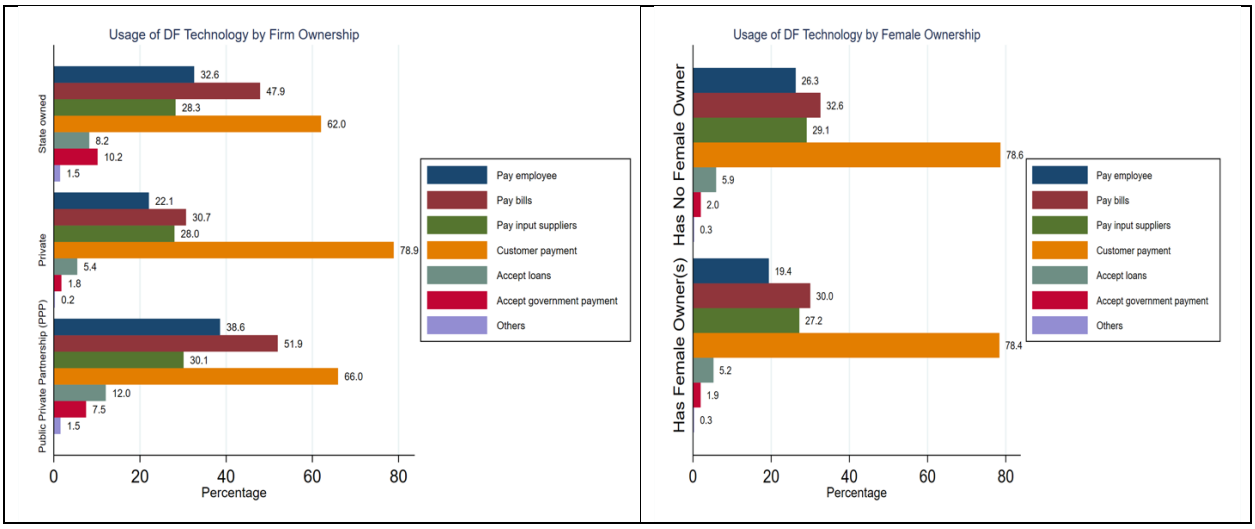
## 3.1 Summary of Response

The predominant use of digital payments technology is for receiving payments from customers, accounting for 78.48% of the usage. Paying bills, input suppliers, and employees are other major purposes for using digital payment.

A breakdown by firm size shows larger firms exhibit a more diverse use of digital payment. For example, among firms with over 100 persons, 65% use digital payment to pay bills and 53% use it for payroll. Small and micro firms predominantly use digital payment for accepting customer payment. This suggests that, as firms grow, they integrate digital payments more comprehensively into various aspects of their operations, not only for revenue intake but also for managing expenditures and other financial interactions.

*Figure 17: Digital Payments Technology Usage*






## 3.2 *Regression Analysis of Impacts of Digital Payments Use on Business Outcomes*

We conducted a regression analysis to examine the effect of digital payments (DP) use on various business outcomes, including firm size, revenue, and formality. The regressions were run with district-level fixed effects to account for regional variation, and with controls for additional business characteristics to ensure robust estimates. The regression models used are as follows:

$$y_i = \alpha + \beta_1 \, DP_i + X \cdot \delta + \gamma District_i + \epsilon_i \quad (2)$$

$$y_i = \alpha + \beta_2 \, DP\_merchant_i + X \cdot \delta + \gamma District_i + \epsilon_i \quad (3)$$

The outcome variable $y_i$ represents business metrics, including the total number of employees, an indicator for whether the annual revenue exceeds GH₵10,000, and a binary variable for whether the business is formally registered. $DP_i$ is a dummy variable equal to 1 if the business has adopted any form of digital payment technology, while $DP\_merchant_i$ is a dummy variable equal to 1 if the business has adopted a merchant account. $X$ is a vector of relevant business characteristics included as control variables. The coefficients $\beta_1$ and $\beta_2$ capture the influence of general digital payments adoption and merchant account adoption on firm size, revenue, and formalization.

**<Table 8: Impacts of Digital Payments on Business Outcomes>**

Table 8 shows the adoption of digital payments generally has a positive impact across all the outcomes considered. Firms that have adopted digital payment technology show a 0.34 or 9%increase in the total number of employees, while the adoption of a merchant

account shows an even greater impact. The coefficient for merchant account adoption is nearly five times larger than that for general digital payments adoption, suggesting that firms using merchant accounts tend to have more employees compared to those that have adopted basic digital payments tools. This may imply merchant account adoption is more strongly associated with the scale of business operations.

Regarding formal business registration, the analysis revealed both general digital payments and merchant account adoption increase the likelihood of being formally registered, though the effect of merchant account adoption is more pronounced. Specifically, firms that use digital payments are 5 percentage points more likely to formalize, while firms with a merchant account are 10 percentage points more likely to do so. This could suggest merchant accounts provide stronger incentives or requirements for formalization compared to general digital payments tools.

Regarding revenue outcomes, the results indicated digital payments adoption increases the probability of a firm having high revenue (above GH₵10,000 annually). While both general digital payments adoption and merchant account usage are positively associated with higher revenue, the magnitude of the effect is larger for general digital payments use compared to merchant accounts. This difference could imply basic digital payments tools, such as personal mobile money, play a more direct role in improving revenue generation by enhancing transaction convenience and expanding market reach, whereas merchant accounts provide broader benefits in terms of business growth and scale rather than immediate revenue increases.

Overall, the findings highlighted the role of digital payments adoption in enhancing business outcomes, such as firm size, formalization, and revenue generation. The adoption of merchant accounts seems to have a stronger association with business growth, both in terms of employee size and formalization, compared to general digital payments adoption. The results underscored the importance of supporting firms in transitioning from personal to merchant digital accounts to fully leverage the benefits of digital payments for business growth and formalization.

# 4 Barriers to Adoption and Usage

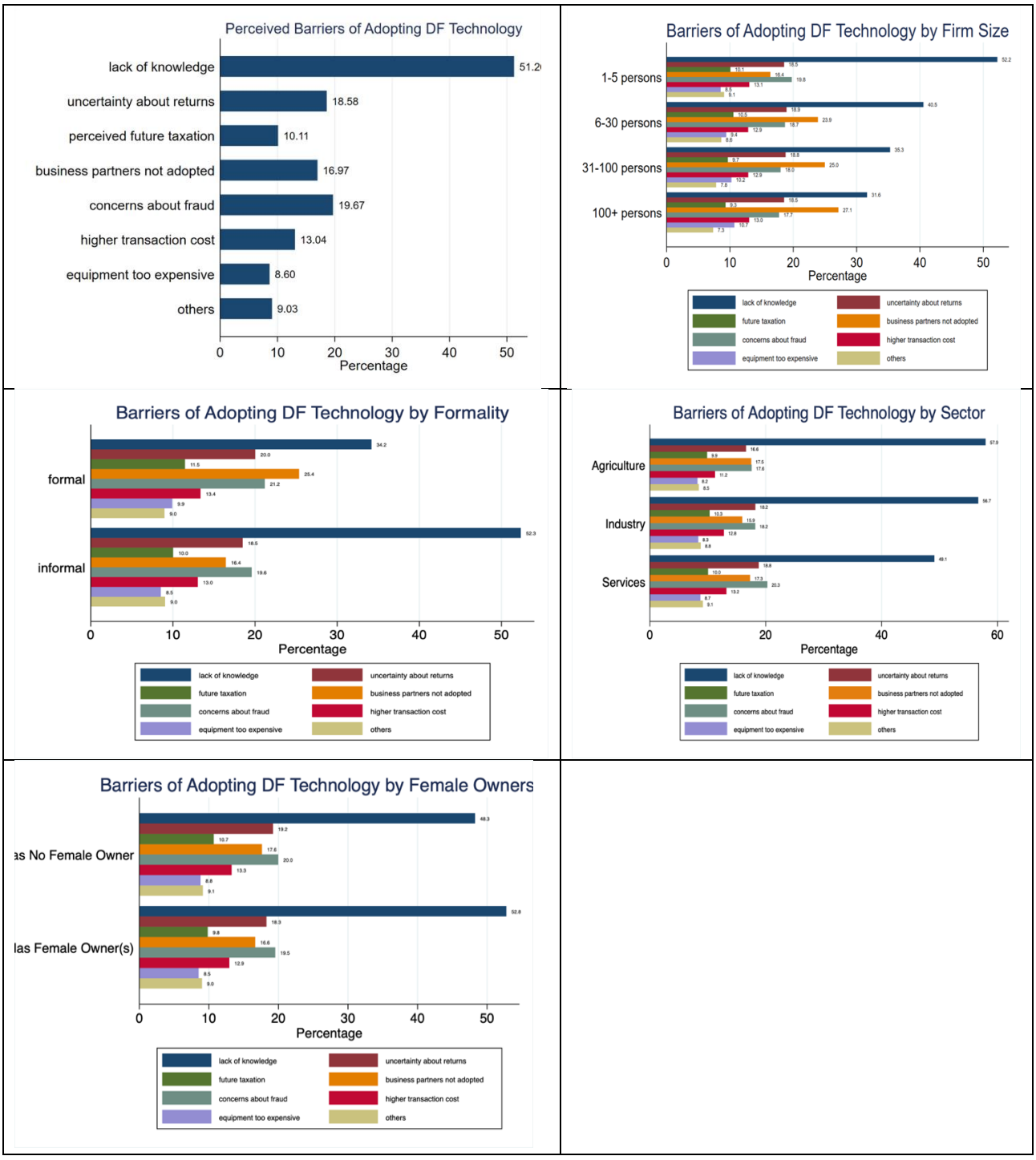
## *4.1 Summary of Response*

The adoption of digital payments technology by businesses in Ghana is hindered by several barriers, which vary depending on such firm characteristics as formality, sector, and gender of ownership (Figure 6).

Lack of knowledge stands out as the most prominent barrier across all firms, with 51.2% of respondents citing it as a reason for not adopting digital payments. This issue is particularly pronounced among informal firms, firms in the agricultural sector, and female-owned businesses. For instance, nearly 54% of informal firms report a lack of knowledge as a barrier, compared to 34% of formal firms. The difference highlights how

informal businesses, which often lack access to educational resources or training, face challenges in adopting digital financial tools.

*Figure 6: Barriers of Adopting Digital Payment Technology*



Concerns about fraud represent the second most significant barrier, cited by 20% of firms across different sizes. Even among larger firms, 18% remain wary of fraud risks associated with digital payment technologies. This concern highlights the need for digital security measures and clear communication about the safety features of digital payment technologies to build trust, detect fraud, and encourage wider adoption.

Uncertainty about the returns or benefits from using digital payment systems remains a widespread issue (18%), affecting firms regardless of size. This underscores the necessity for stakeholders in the digital payments sector to provide concrete data and case studies that clearly demonstrate the financial and operational returns of digital payments, which could help to mitigate hesitancy and bolster confidence among potential users.

A notable barrier, especially for larger firms and formal businesses, is the lack of adoption among partners, including suppliers, customers, and competitors. About 17% of firms are hesitant to adopt digital payment technologies because their business ecosystem has not embraced these tools. This situation indicates a need for a coordinated approach to promoting digital payment technologies, one that encompasses all segments of the market and parts of the business supply chain to create a unified shift towards digitalization.

In summary, these insights reveal a multi-faceted landscape of barriers to digital payment technology adoption that spans educational deficiencies to ecosystem readiness. Addressing these barriers through tailored educational programs, clear demonstration of benefits, enhanced security measures, and market-wide promotional strategies could significantly increase the penetration and effectiveness of digital payment technologies across all sectors.

# 5. Female Leadership and Business/ DFS Growth

## *5.1 Business Characteristics and Gender*

To analyze how the gender of a business owner affects business outcomes, we conducted a regression analysis using the following model:

$$y_i = \alpha + \beta Female\ Owner_i + \gamma District_i + \epsilon_i \quad (4)$$

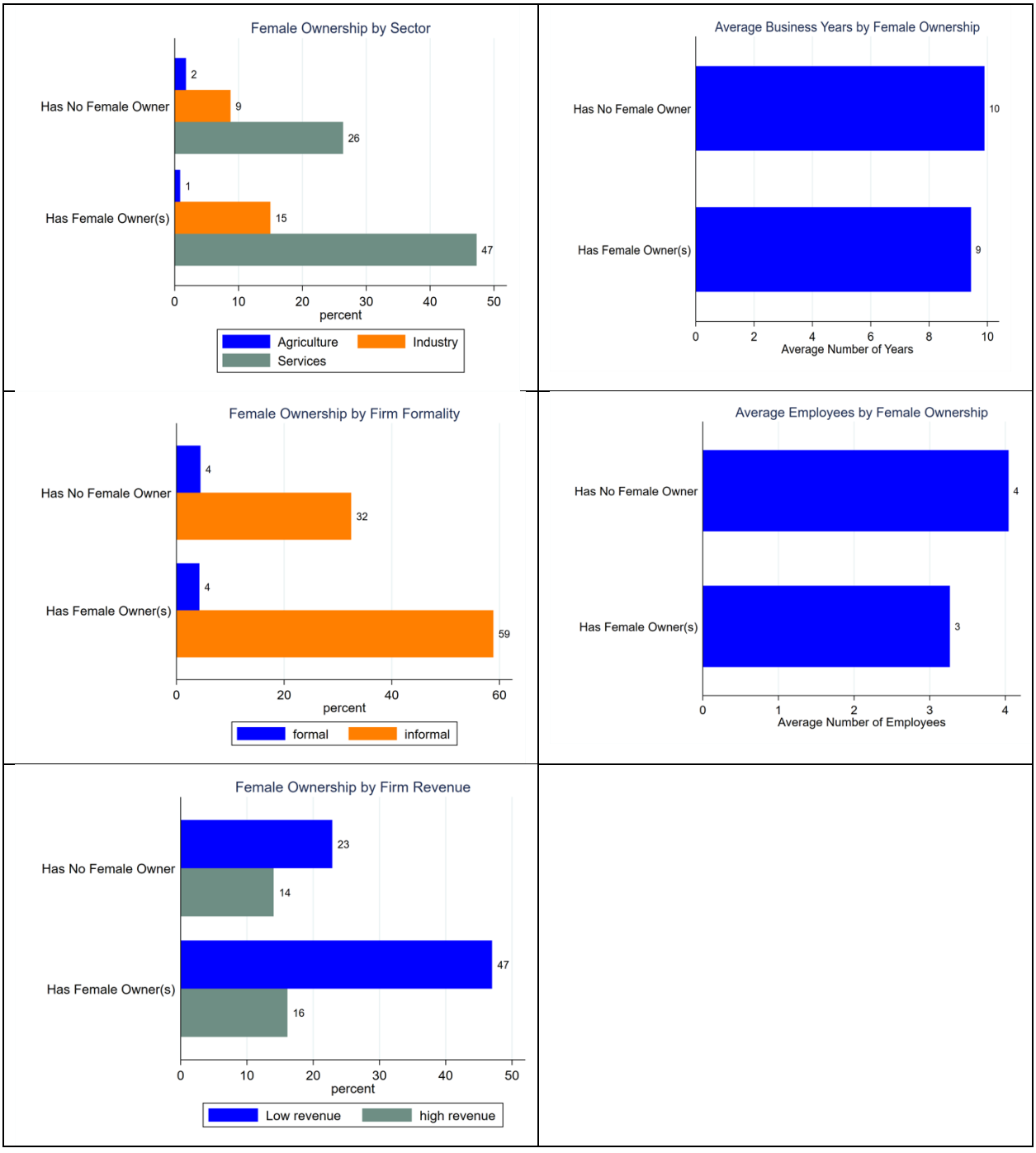
$$y_i = \alpha + \beta Female\ Manager_i + \gamma District_i + \epsilon_i \quad (5)$$

Where $y_i$ represents business outcomes, including firm size as measured by the number of employees, firm age, firm revenue, formality, and sectors. $Female\ Owner_i$ is a dummy variable equal to 1 if the firm has at least one female owner. District-level fixed effects ($\gamma District_i$) are included to control for regional factors, and $\epsilon_i$ is the error term.

<Table 9:Female Ownership and Business Outcomes>

The coefficients for female ownership in Table 9 is negative and significant across multiple business outcomes, indicating that female-owned firms tend to be smaller, younger, and less profitable compared to male-owned firms. Specifically, female-owned businesses employ on average 0.761 fewer employees or 20% less. Additionally, female-owned firms are, on average, 0.432 years younger, suggesting these businesses may face challenges in sustaining long-term growth.

*Figure 7: Female Ownership and Business Characteristics*



Revenue outcomes also exhibit a disparity: female-owned firms are 12.1 percentage points less likely to report high revenue (above GH₵10,000). This result suggests female-owned firms face structural barriers that limit the ability to generate higher revenues, which could be attributed to limited access to finance, inadequate initial capital investments, or restricted market opportunities.

The results further show female ownership is negatively associated with formal business registration. Female-owned firms are 5.2 percentage points less likely to be formally registered compared to male-owned firms. This finding highlights female-owned businesses may be more likely to remain in the informal sector, potentially due to constraints related to administrative procedures, a lack of resources, or barriers to formalization. Several informal businesses are concentrated in services-related business, as female-owned firms are 3.9 percentage points more likely to be in the services sectors and 3.5 percentage points less likely to be in the agricultural sector.

Overall, the regression results indicated female-owned businesses face significant disadvantages in terms of size, age, revenue, and formalization. Female-owned firms are generally smaller, younger, and less likely to be formally registered or to report high revenues. Furthermore, they are more concentrated in the services sector compared to agriculture or manufacturing. However, the results should be interpreted with caution due to the low R-squared values reported in the regression models, suggesting an owner's gender explains only a small portion of the variability in business outcomes.

Despite these limitations, the findings highlight areas where female-owned businesses face challenges, and underscore the need for targeted policy interventions to support female entrepreneurs. Addressing barriers to formalization, expanding access to finance, and providing capacity-building initiatives may help female-owned firms to overcome these challenges. Furthermore, encouraging female entrepreneurship across diverse sectors, beyond services, could help to create more balanced growth opportunities for women in business.

### *5.2 Digital Payments and Gender*

We further examined the effect of female leadership on the adoption of digital payments considering both overall adoption and the adoption of merchant accounts. To do this, we conducted regression analyses as Equations (4) and (5) to understand whether businesses owned or managed by women differ in the levels of digital payments adoption compared to businesses led by men. Specifically, two versions of the independent variable were used: one indicating whether the firm has a female owner, and the other indicating whether the firm has a female manager. This approach enabled the analysis to capture the influence of female leadership on digital payments adoption, whether through ownership or managerial control.

$$y_i = \alpha + \beta Female\ Owner_i + X\delta + \gamma District_i + \epsilon_i \quad (6)$$

$$y_i = \alpha + \beta Female\ Manager_i + X\delta + \gamma District_i + \epsilon_i \quad (7)$$

**Table 6: Digital Payments Adoption and Female Leadership**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | digital | digital | digital merchant | digital merchant |
| has female owners | -0.093*** | -0.072*** | -0.054*** | -0.037*** |
| | (0.005) | (0.003) | (0.004) | (0.002) |
| has female managers | -0.081*** | -0.057*** | -0.052*** | -0.031*** |
| | (0.005) | (0.003) | (0.004) | (0.003) |
| R-squared | 0.425 | 0.450 | 0.261 | 0.288 |
| Observations | 1,855,343 | 1,855,163 | 688,159 | 688,065 |
| Mean of Outcome | 0.371 | 0.371 | 0.231 | 0.231 |
| Controls | No | Yes | No | Yes |

*Notes:* Each coefficient is from a separate regression. The control variables in columns 2 and 4 include firm size, sector, revenue, formality, and years of business. Standard errors in parentheses * p<0.10, ** p<0.05, *** p<0.01

The results are presented in Table 6, and each coefficient is from a separate regression, each examining the impacts of female leadership on overall digital payments adoption or merchant account adoption, both with and without control variables.

The regression results highlight significant differences in digital payments adoption between female-led firms and male-led firms. Both female ownership and female management are negatively associated with digital payments adoption, a trend consistent across both overall digital payment use and merchant account adoption.

Female-owned firms are less likely to adopt digital payments. Without controlling for other business characteristics, female-owned firms are 9.3 percentage points less likely to adopt digital payment tools compared to male-owned firms (column 1). Even after adjusting for factors, such as firm size, sector, revenue, formality, and years in business, female-owned firms remain 7.2 percentage points less likely to adopt digital payments (column 2), suggesting gender-based barriers persist even when accounting for other business attributes. A similar pattern emerges for merchant account adoption. Female-owned firms are 5.4 percentage points less likely to adopt a merchant account, and this effect, while slightly reduced to 3.7 percentage points after controlling for additional firm characteristics, remains statistically significant (columns 3 and 4). This indicates female ownership presents a consistent barrier to adopting merchant accounts, regardless of the firm's specific attributes.

The analysis also considered the role of female management, which similarly revealed a negative impact on digital payments adoption, though the magnitude is slightly smaller

compared to female ownership. Female-managed firms are 8.1 percentage points less likely to adopt digital payments overall, and this effect is reduced to 5.7 percentage points after adjusting for business characteristics. The lower likelihood of digital payments adoption persists even for merchant account use, with female-managed firms being 5.2 percentage points less likely to adopt merchant accounts, and 3.1 percentage points less likely when additional controls are included.

The revenue benefit of digital adoption is weaker for female-owned businesses compared to male-owned businesses that have also adopted digital payment tools. For example, the combined effect of female ownership and digital adoption reduces the likelihood of achieving high revenue by 3.8 percentage points compared to male-owned businesses that adopt digital tools (Table 11). This diminished joint effect could reflect unique challenges faced by female entrepreneurs, such as lower digital literacy, limited market access, or constrained business scale, which may hinder the ability to fully leverage digital tools for revenue growth.

Overall, the results indicate both female ownership and management are associated with lower rates of digital payments adoption, regardless of whether it is general adoption or specific to merchant accounts. Even after accounting for key business characteristics, these gender-related barriers remain significant, underscoring the structural challenges female-led businesses face in accessing digital payments tools. This points to the need for targeted interventions to support female entrepreneurs and managers. Addressing these challenges is crucial to enhancing financial inclusion and ensuring female-owned and managed firms fully benefit from the opportunities offered by digital financial technologies.

### *5.3 Female Ownership and Management*

Businesses show a significant concentration of female leadership and limited cross-gender collaboration (Table 7). Specifically, 58.7% of businesses have both female owners and female managers, while 33.5% are entirely male-led. Mixed-gender leadership—male owners with female managers (3.4%) or female owners with male managers (4.4%)—is relatively uncommon.

**Table 7: Distribution of business by leadership types**

| Leadership Type | Num of business | Percent |
|---|---|---|
| **has only male owners x has only male managers** | 621,342 | 33.5% |
| **has only male owners x has female managers** | 63,255 | 3.4% |
| **has female owners x has only male managers** | 82,393 | 4.4% |
| **has female owners x has female managers** | 1,088,851 | 58.7% |
| **Total** | 1,855,841 | 100% |

To assess how sorting between female owners and female managers affects business outcomes and digital payments adoption, the analysis used a regression model with the interaction terms, as in equation ( 8):

$$y_i = \alpha + \beta Female\ Manager_i \times Female\ Owner_i + \gamma District_i + \epsilon_i \quad (8)$$

Table 13 reports the relationship between gender composition in business leadership and two key outcomes: revenue performance and digital payments adoption. Firms with female managers but no female owners are 2.9 percentage points more likely to report high revenue (exceeding GH₵10,000 in 2023) relative to the baseline group of male-owned and male-managed firms. In contrast, firms with female owners but no female managers are 9.5 percentage points less likely to achieve high revenue. Similarly, businesses with both female owners and managers underperform in revenue, with a 10.7 percentage-point lower likelihood of meeting the high-revenue threshold.

Controlling for the gender composition of workers does not change these correlations (Table 14). A higher share of female workers is associated with lower revenue and digital adoption rate, but the positive effect of female managers remains unchanged. These results suggest female representation in management, rather than ownership alone or combined leadership, is strongly associated with higher revenue performance.

Descriptive evidence indicates the revenue premium associated with female managers are more pronounced in small businesses with 6-30 persons, those that are formally registered, and those operating in the service sectors, particularly in the Greater Accra and Eastern regions (Table 15 and 17, Figure 2).

The adoption of digital payment services is generally lower among businesses with female leadership in all forms (column 2). Conditional on adopting digital payment, the authors also considered account types – either personal account or dedicated merchant account. Businesses with female managers but no female owners are 4.9 percentage points more likely to adopt merchant accounts (column 4). Similarly, firms with female owners but no female managers show a modest positive effect (1.6 percentage points). This indicates female managers have the potential to excel in operational decision-making that emphasizes business efficiency, even within male-owned businesses.

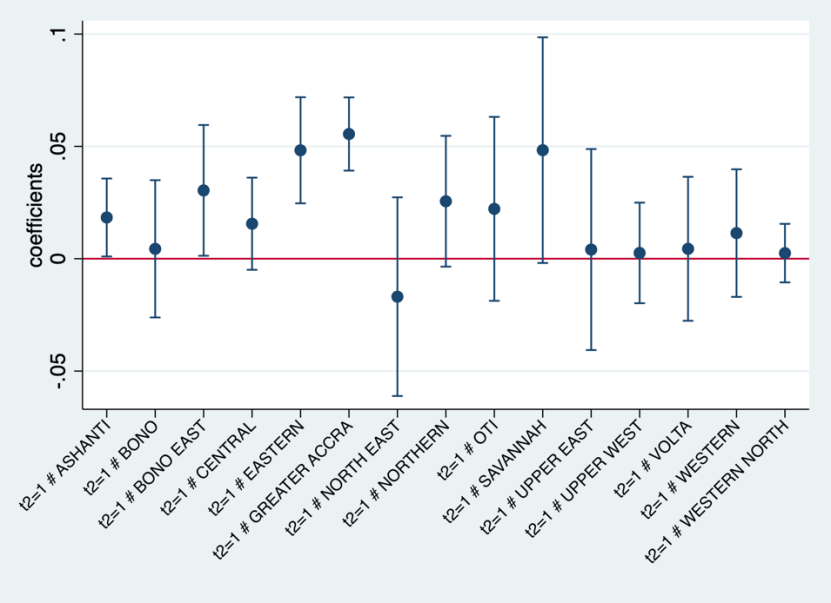
Businesses with both female owners and managers are 4.4 percentage points less likely to adopt merchant accounts but 1.1 percentage points more likely to adopt personal accounts. Such a divergence may reflect differences in business priorities or models, where such firms may prioritize informal or alternative payment methods over formal digital tools for operations.

Similar to the effect of having female managers, the presence of female workers in male-owned firms is associated with higher revenue and greater digital payments adoption rate than in fully male-owned and operated businesses (Table 17). Male-owned and managed firms that employ female workers appear to benefit significantly, exhibiting

higher revenues and broader adoption of digital payment options than the fully male-staffed comparison group. Specifically, these firms are 9.2 percentage points more likely to generate high revenue and 8.3 percentage points more likely to adopt digital payments (Table 20).

Moreover, male-owned firms see an additional boost when female managers are supported by female workers, achieving even stronger gains in revenue and merchant digital payment usage. In contrast, if female managers operate without female workers, their impact on business outcomes is muted, with no statistically significant improvement in revenue or digital payments adoption (Table 20).

*Figure 20: Effects of Leadership Composition on Revenue by Regions*




*Notes:* The figures display the coefficients and confidence intervals for the interaction terms of businesses that have only male owners with female managers and their location (e.g., a business has no female owner x female manager x region). The baseline comparison group consists of businesses with only male owners and male managers. The regression includes controls for business size, years in operation, and sector.

*Figure 8: Female Management and Business Characteristics*

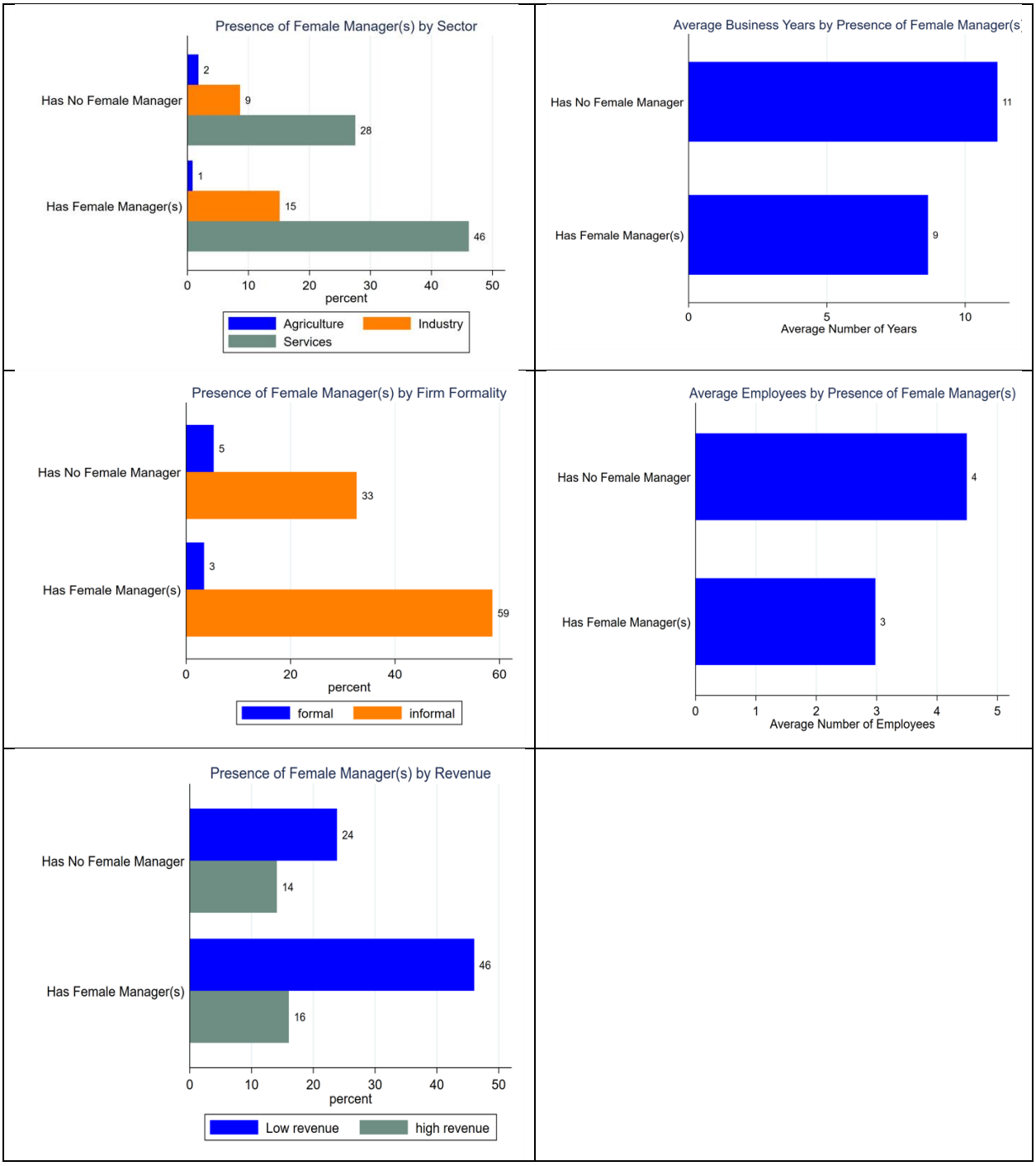


**Table 8: Impacts of Digital Payments on Business Outcomes**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Total employee | Total employee | Formal business (0/1) | Formal business (0/1) | High revenue (0/1) | High revenue (0/1) |
| Digital | 0.338*** | | 0.048*** | | 0.164*** | |
| | (0.087) | | (0.002) | | (0.004) | |
| digital merchant | | 1.656*** | | 0.104*** | | 0.078*** |
| | | (0.332) | | (0.004) | | (0.008) |
| Agriculture | 0.316* | 2.012*** | -0.040*** | -0.047*** | 0.063*** | 0.088*** |
| | (0.184) | (0.450) | (0.004) | (0.007) | (0.008) | (0.012) |
| Manufacturing | 0.197 | 1.167*** | -0.058*** | -0.083*** | -0.011*** | -0.036*** |
| | (0.148) | (0.255) | (0.001) | (0.002) | (0.003) | (0.004) |
| Formal | 10.889*** | 10.420*** | | | | |
| | (0.528) | (0.726) | | | | |
| has female owners | -0.149 | 0.336 | -0.038*** | -0.059*** | -0.097*** | -0.113*** |
| | (0.105) | (0.219) | (0.002) | (0.002) | (0.003) | (0.003) |
| 1-5 persons | | | -0.521*** | -0.604*** | -0.262*** | -0.319*** |
| | | | (0.014) | (0.014) | (0.014) | (0.016) |
| 6-30 persons | | | -0.244*** | -0.318*** | -0.095*** | -0.119*** |
| | | | (0.012) | (0.015) | (0.012) | (0.014) |
| 31-100 persons | | | -0.065*** | -0.041*** | -0.054*** | -0.022 |
| | | | (0.012) | (0.014) | (0.011) | (0.014) |
| R-squared | 0.005 | 0.003 | 0.141 | 0.158 | 0.106 | 0.087 |
| Observations | 1,855,163 | 688,065 | 1,855,163 | 688,065 | 1,855,163 | 688,065 |
| Mean of Outcome | 3.553 | 4.202 | 0.087 | 0.133 | 0.301 | 0.420 |

*Note*: The outcome variable "High Revenue" in columns 5 and 6 are a dummy variable equal to 1 if the annual revenue exceeded GH₵10,000 in 2023. Standard errors in parentheses * p<0.10, ** p<0.05, *** p<0.01

**Table 9:Female Ownership and Business Outcomes**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | Total employee | Years of business | High revenue | Formal business | Agriculture | Manufacturing | Services |
| has female owners | -0.761*** | -0.432*** | -0.121*** | -0.052*** | -0.035*** | -0.004 | 0.039*** |
| | (0.110) | (0.075) | (0.003) | (0.003) | (0.003) | (0.007) | (0.006) |
| R-squared | 0.000 | 0.030 | 0.064 | 0.028 | 0.048 | 0.031 | 0.046 |
| Observations | 1,855,346 | 1,855,343 | 1,855,343 | 1,855,841 | 1,855,187 | 1,855,187 | 1,855,187 |
| Mean of Outcome | 3.553 | 9.608 | 0.301 | 0.087 | 0.026 | 0.237 | 0.736 |

*Note*: The outcome variable "High Revenue" in column 3 is a dummy variable equal to 1 if the annual revenue exceeded GH₵10,000 in 2023. Standard errors clustered at district level are in parentheses * p<0.10, ** p<0.05, *** p<0.01

**Table 10: Female Management and Business Outcomes**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | Total employee | Years of business | High revenue | Formal business | Agriculture | Manufacturing | Services |
| has female managers | -1.501*** | -2.425*** | -0.111*** | -0.084*** | -0.034*** | 0.014* | 0.020*** |
| | (0.077) | (0.088) | (0.003) | (0.002) | (0.002) | (0.008) | (0.006) |
| R-squared | 0.001 | 0.041 | 0.061 | 0.041 | 0.047 | 0.031 | 0.045 |
| Observations | 1,855,346 | 1,855,343 | 1,855,343 | 1,855,841 | 1,855,187 | 1,855,187 | 1,855,187 |
| Mean of Outcome | 3.553 | 9.608 | 0.301 | 0.087 | 0.026 | 0.237 | 0.736 |

*Note:* The outcome variable "High Revenue" in column 3 is a dummy variable equal to 1 if the annual revenue exceeded GH₵10,000 in 2023. Standard errors clustered at district level are in parentheses * p<0.10, ** p<0.05, *** p<0.01

**Table 11. Business outcomes and female owners conditional on DFS**

| | (1) Total employee | (2) Years of business | (3) High revenue | (4) Formal business | (5) Agriculture | (6) Manufacturing | (7) Services |
|---|---|---|---|---|---|---|---|
| has female owners | -0.685*** | -0.498*** | -0.090*** | -0.027*** | -0.047*** | 0.004 | 0.044*** |
| | (0.098) | (0.078) | (0.003) | (0.002) | (0.004) | (0.008) | (0.006) |
| Digital | 0.955*** | -0.702*** | 0.194*** | 0.090*** | -0.029*** | 0.007* | 0.022*** |
| | (0.112) | (0.072) | (0.005) | (0.002) | (0.003) | (0.004) | (0.005) |
| has female owners x digital | 0.051 | -0.007 | -0.038*** | -0.049*** | 0.028*** | -0.019*** | -0.009* |
| | (0.183) | (0.066) | (0.004) | (0.002) | (0.003) | (0.005) | (0.005) |
| R-squared | 0.001 | 0.031 | 0.093 | 0.039 | 0.051 | 0.031 | 0.047 |
| Observations | 1,855,342 | 1,855,341 | 1,855,343 | 1,855,343 | 1,855,164 | 1,855,164 | 1,855,164 |
| Mean of Outcome | 3.553 | 9.608 | 0.301 | 0.087 | 0.026 | 0.237 | 0.736 |

Standard errors in parentheses * p<0.10, ** p<0.05, *** p<0.01

**Table 12: Business outcomes and female managers conditional on DFS**

| | (1) Total employee | (2) Years of business | (3) High revenue | (4) Formal business | (5) Agriculture | (6) Manufacturing | (7) Services |
|---|---|---|---|---|---|---|---|
| has female managers | -1.760*** | -2.942*** | -0.081*** | -0.069*** | -0.044*** | 0.028*** | 0.017** |
| | (0.076) | (0.105) | (0.003) | (0.002) | (0.003) | (0.008) | (0.007) |
| Digital | 0.405*** | -1.566*** | 0.197*** | 0.072*** | -0.027*** | 0.019*** | 0.008* |
| | (0.100) | (0.096) | (0.005) | (0.003) | (0.003) | (0.004) | (0.004) |
| has female managers x digital | 0.867*** | 1.138*** | -0.041*** | -0.025*** | 0.025*** | -0.037*** | 0.012** |
| | (0.185) | (0.081) | (0.004) | (0.002) | (0.003) | (0.005) | (0.005) |
| R-squared | 0.001 | 0.044 | 0.092 | 0.050 | 0.050 | 0.031 | 0.045 |
| Observations | 1,855,342 | 1,855,341 | 1,855,343 | 1,855,343 | 1,855,164 | 1,855,164 | 1,855,164 |
| Mean of Outcome | 3.553 | 9.608 | 0.301 | 0.087 | 0.026 | 0.237 | 0.736 |

Standard errors in parentheses * p<0.10, ** p<0.05, *** p<0.01

**Table 13: Leadership Composition and Business Outcomes**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | **High revenue (0/1)** | **Digital (0/1)** | **Digital personal (0/1)** | **Digital merchant (0/1)** |
| has no female owner x has female managers | 0.029*** | -0.007** | -0.031*** | 0.049*** |
| | (0.004) | (0.003) | (0.003) | (0.005) |
| has female owners x has no female managers | -0.095*** | -0.089*** | -0.049*** | 0.016*** |
| | (0.005) | (0.005) | (0.003) | (0.004) |
| has female owners x has female managers | -0.107*** | -0.091*** | 0.011*** | -0.044*** |
| | (0.003) | (0.003) | (0.001) | (0.003) |
| R-squared | 0.086 | 0.102 | 0.055 | 0.069 |
| Observations | 1,855,162 | 1,855,162 | 688,064 | 688,064 |
| Mean of Outcome | 0.301 | 0.371 | 0.954 | 0.231 |

*Note*: The comparison group is businesses with only male owners and male managers. The outcome variable "High Revenue" in column 1 is a dummy variable equal to 1 if the annual revenue exceeded GH₵10,000 in 2023. The adoption of merchant and personal accounts is conditional on the overall adoption of digital payments, which results in a smaller number of observations for regressions in columns 3 and 4. All regressions include controls for firm size, sector, revenue, formality, years of business, and district-fixed effect. Standard errors clustered at district level are in parentheses * p<0.10, ** p<0.05, *** p<0.01

**Table 14: Leadership and Worker Composition and Business Outcomes**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | High revenue (0/1) | Digital (0/1) | Digital personal (0/1) | Digital merchant (0/1) |
| has no female owner x has female managers | 0.060*** | -0.003 | -0.032*** | 0.054*** |
| | (0.004) | (0.003) | (0.003) | (0.005) |
| has female owners x has no female managers | -0.077*** | -0.086*** | -0.049*** | 0.018*** |
| | (0.005) | (0.005) | (0.003) | (0.004) |
| has female owners x has female managers | -0.057*** | -0.085*** | 0.009*** | -0.035*** |
| | (0.003) | (0.004) | (0.002) | (0.004) |
| percent of female workers | -0.063*** | -0.010*** | 0.003 | -0.012*** |
| | (0.003) | (0.003) | (0.002) | (0.003) |
| percent of male workers | 0.001*** | 0.000*** | -0.000** | 0.000** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| R-squared | 0.088 | 0.103 | 0.055 | 0.070 |
| Observations | 1,855,186 | 1,855,184 | 688,073 | 688,073 |
| Mean of Outcome | 0.303 | 0.371 | 0.954 | 0.231 |

*Note:* The comparison group is businesses with only male owners and male managers. The outcome variable "High Revenue" in column 1 is a dummy variable equal to 1 if the annual revenue exceeded GH₵10,000 in 2023. The dependent variables "percent of female workers" and "percent of male workers" range from 0 to 1. All regressions include controls for firm size, sector, revenue, formality, years of business, and district-fixed effect. The adoption of merchant and personal accounts is conditional on the overall adoption of digital payments, which results in a smaller number of observations for regressions in columns 3 and 4. Standard errors clustered at district level are in parentheses * p<0.10, ** p<0.05, *** p<0.01

**Table 15: Leadership Composition and Business Characteristics**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | **Total employee** | **years of business** | **High revenue** | **Formal business** | **Agriculture** | **Manufacturing** | **Services** |
| has no female owner x has female managers | 4.744*** | 0.127 | 0.049*** | 0.098*** | -0.019*** | -0.080*** | 0.099*** |
| | (0.525) | (0.078) | (0.004) | (0.005) | (0.002) | (0.004) | (0.004) |
| has female owners x has no female managers | 7.612*** | 10.594*** | -0.025*** | 0.240*** | -0.025*** | -0.155*** | 0.180*** |
| | (0.287) | (0.372) | (0.005) | (0.005) | (0.003) | (0.004) | (0.005) |
| has female owners x has female managers | -0.926*** | -1.262*** | -0.124*** | -0.065*** | -0.038*** | -0.000 | 0.038*** |
| | (0.075) | (0.066) | (0.003) | (0.002) | (0.003) | (0.008) | (0.007) |
| R-squared | 0.002 | 0.080 | 0.066 | 0.080 | 0.049 | 0.037 | 0.052 |
| Observations | 1,855,346 | 1,855,343 | 1,855,343 | 1,855,841 | 1,855,187 | 1,855,187 | 1,855,187 |
| Mean of Outcome | 3.553 | 9.608 | 0.301 | 0.087 | 0.026 | 0.237 | 0.736 |

*Note*: The comparison group is businesses with only male owners and male managers.

**Table 16: Leadership Composition and Business Sizes**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | **1-5 persons Micro Business** | **6-30 persons Small Business** | **31-100 persons Medium Business** | **100+ persons Large Business** |
| has no female owner x has female managers | -0.088*** | 0.065*** | 0.015*** | 0.008*** |
| | (0.005) | (0.003) | (0.001) | (0.001) |
| has female owners x has no female managers | -0.248*** | 0.202*** | 0.031*** | 0.015*** |
| | (0.006) | (0.005) | (0.001) | (0.001) |
| has female owners x has female managers | 0.048*** | -0.043*** | -0.004*** | -0.001*** |
| | (0.002) | (0.002) | (0.000) | (0.000) |
| R-squared | 0.056 | 0.043 | 0.011 | 0.005 |
| Observations | 1,855,346 | 1,855,346 | 1,855,346 | 1,855,346 |
| Mean of Outcome | 0.908 | 0.082 | 0.007 | 0.003 |

*Note:* The comparison group is businesses with only male owners and male managers.

**Table 17: Ownership and Worker Composition and Business Outcomes**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | **High revenue (0/1)** | **Digital (0/1)** | **Digital personal (0/1)** | **Digital merchant (0/1)** |
| has no female owner x has female workers | 0.081*** | 0.062*** | -0.032*** | 0.056*** |
| | (0.003) | (0.003) | (0.002) | (0.004) |
| has female owners x has no female workers | -0.046*** | -0.076*** | -0.029*** | 0.015*** |
| | (0.005) | (0.005) | (0.004) | (0.006) |
| has female owners x has female workers | -0.088*** | -0.076*** | 0.000 | -0.028*** |
| | (0.003) | (0.004) | (0.001) | (0.003) |
| R-squared | 0.089 | 0.104 | 0.054 | 0.070 |
| Observations | 1,855,186 | 1,855,184 | 688,073 | 688,073 |
| Mean of Outcome | 0.303 | 0.371 | 0.954 | 0.231 |

*Note:* The comparison group is businesses with only male owners and male workers. The outcome variable "High Revenue" in column 1 is a dummy variable equal to 1 if the annual revenue exceeded GH₵10,000 in 2023. The adoption of merchant and personal accounts is conditional on the overall adoption of digital payments, which results in a smaller number of observations for regressions in columns 3 and 4. All regressions include controls for firm size, sector, revenue, formality, years of business, and district fixed effect. Standard errors clustered at district level are in parentheses * p<0.10, ** p<0.05, *** p<0.01

**Table 18: Worker Composition and Business Characteristics**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | Total employee | years of business | High revenue | Formal business | Agriculture | Industry | Services |
| has no female owner x has female workers | 6.849*** | 0.980*** | 0.119*** | 0.180*** | -0.015*** | -0.113*** | 0.128*** |
| | (0.304) | (0.086) | (0.004) | (0.006) | (0.002) | (0.004) | (0.005) |
| has female owners x has no female workers | 0.329** | 5.619*** | -0.004 | 0.157*** | -0.015*** | -0.137*** | 0.152*** |
| | (0.129) | (0.302) | (0.005) | (0.005) | (0.003) | (0.005) | (0.006) |
| has female owners x has female workers | 1.158*** | -0.361*** | -0.093*** | -0.008*** | -0.040*** | -0.031*** | 0.071*** |
| | (0.082) | (0.086) | (0.003) | (0.001) | (0.003) | (0.008) | (0.007) |
| R-squared | 0.002 | 0.037 | 0.070 | 0.065 | 0.049 | 0.037 | 0.053 |
| Observations | 1,855,198 | 1,855,191 | 1,855,198 | 1,855,198 | 1,855,190 | 1,855,190 | 1,855,190 |
| Mean of Outcome | 3.553 | 9.608 | 0.303 | 0.087 | 0.026 | 0.237 | 0.736 |

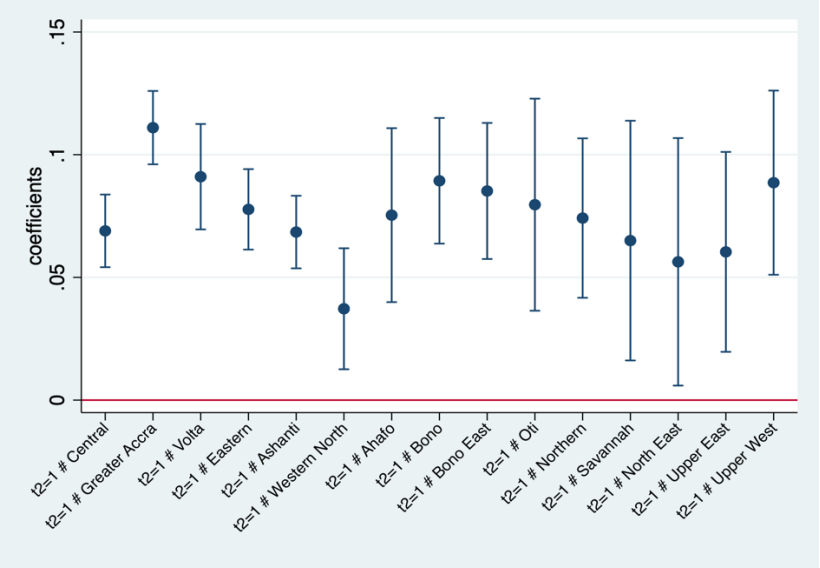
*Note*: The comparison group is businesses with only male owners and male workers.

**Table 19: Worker Composition and Firm Sizes**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | 1-5 persons Micro Business | 6-30 persons Small Business | 31-100 persons Medium Business | 100+ persons Large Business |
| has no female owner x has female workers | -0.217*** | 0.178*** | 0.028*** | 0.010*** |
| | (0.004) | (0.003) | (0.001) | (0.001) |
| has female owners x has no female workers | -0.017*** | 0.017*** | -0.000 | 0.000** |
| | (0.003) | (0.003) | (0.000) | (0.000) |
| has female owners x has female workers | -0.024*** | 0.017*** | 0.005*** | 0.002*** |
| | (0.003) | (0.002) | (0.000) | (0.000) |
| R-squared | 0.052 | 0.040 | 0.011 | 0.004 |
| Observations | 1,855,195 | 1,855,195 | 1,855,195 | 1,855,195 |
| Mean of Outcome | 0.908 | 0.082 | 0.007 | 0.003 |

*Note*: The comparison group is businesses with only male owners and male managers.

*Figure 9: Effects of Worker Composition on Revenue by Regions*




*Notes:* The figures display the coefficients and confidence intervals for the interaction terms of businesses that have only male owners with female workers and their location (e.g., has no female owner x female worker x region). The baseline comparison group consists of businesses with only male owners and male workers. The regression includes controls for business size, years in operation, and sector.

**Table 20: Ownership, Management, and Worker Composition**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | High revenue | digital | digital personal | digital merchant |
| has no female owners x has no female managers x has female workers | 0.092*** | 0.083*** | -0.030*** | 0.052*** |
| | (0.003) | (0.004) | (0.002) | (0.004) |
| has no female owners x has female managers x has no female workers | 0.010 | 0.003 | -0.006 | -0.002 |
| | (0.008) | (0.007) | (0.004) | (0.009) |
| has no female owners x has female managers x has female workers | 0.056*** | 0.013*** | -0.044*** | 0.072*** |
| | (0.005) | (0.004) | (0.003) | (0.006) |
| has female owners x has no female managers x has no female workers | -0.060*** | -0.090*** | -0.038*** | 0.016*** |
| | (0.005) | (0.006) | (0.004) | (0.006) |
| has female owners x has no female managers x has female workers | -0.070*** | -0.051*** | -0.070*** | 0.042*** |
| | (0.006) | (0.006) | (0.003) | (0.006) |
| has female owners x has female managers x has no female workers | 0.037*** | 0.009 | -0.006 | 0.021* |
| | (0.009) | (0.008) | (0.006) | (0.012) |
| has female owners x has female managers x has female workers | -0.089*** | -0.077*** | 0.004*** | -0.031*** |
| | (0.003) | (0.004) | (0.001) | (0.003) |
| R-squared | 0.090 | 0.105 | 0.057 | 0.071 |
| Observations | 1,855,186 | 1,855,184 | 688,073 | 688,073 |
| Mean of Outcome | 0.303 | 0.371 | 0.954 | 0.231 |

*Note*: The comparison group is businesses with only male owners, male managers, and male workers. The outcome variable "High Revenue" in column 1 is a dummy variable equal to 1 if the annual revenue exceeded GH₵10,000 in 2023. The adoption of merchant and personal accounts is conditional on the overall adoption of digital payments, which results in a smaller number of observations for regressions in columns 3 and 4. All regressions include controls for firm size, sector, revenue, formality, years of business, and district-fixed effect. Standard errors clustered at district level are in parentheses * p<0.10, ** p<0.05, *** p<0.01