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Firm Credit Constraints and Electronic Payments

A Global Analysis

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Abstract

Understanding the drivers of credit constraints is essential for fostering private sector development and firm growth. This study examines the channels through which electronic payments influence firm credit constraints across 101 economies. It explores heterogeneity at the firm and aggregate levels to identify key policy and environmental factors that shape this relationship. The findings indicate that payment digitalization plays a critical role in alleviating firm credit constraints, particularly for small firms and in economies with weaker credit infrastructure and lower levels of financial development. These results support the view that electronic payments help reduce information asymmetries between firms and lenders, thereby improving lending opportunities

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Firm Credit Constraints and Electronic Payments: A Global Analysis

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1. Introduction

Financial constraints hinder private sector development by reducing firm investment and diminishing the efficiency of firm operations. A large literature examines how various factors explain financial constraints for firms. Yet little is known about the potential benefits related to a key recent driver of economic development: firms' adoption of digital technologies. Digitalization may contribute to reducing frictions that impair the financing of productive factors so that firms can conduct business operations. In this paper we fill this gap and investigate whether payment digitalization lessens credit constraints in a sample of 101 countries around the world at different levels of economic development.

The diffusion and adoption of information technologies promise accelerated firm growth through improvements in the business process and increase in the accumulation of intangible capital (Nayyar et al., 2024). Although there is a growing literature on the effects of digital payments, and digital financial services (DFS) in general, the evidence at the firm level is sparse. Khera et al. (2021) shows a positive association between digital financial inclusion and GDP per capita across emerging markets and developing economies (EMDEs), arguing that promoting technological innovation in the payments landscape can help bridge gaps in financial access caused by limitations in traditional banking. Aguilar et al. (2024) find that increases in the use of digital payments are associated with increases in the growth of GDP per capita. Cevik (2024) further emphasizes that Fintech[1] can serve as an accelerator of economic growth, particularly through digital lending in developing economies. One mechanism through which this occurs is the use of DFS to pay workers, which has been shown to increase savings, enhance financial literacy, and improve security and privacy of payments (Breza et al., 2020). By the same token, Ghosh et al. (2025) argue that, especially for small busi-

[1]One definition of Fintech is technological enabled innovation in financial services that may result in new business models, applications, processes or products affecting the provision of financial services (see https://www.fsb.org/work-of-the-fsb/financial-innovation-and-structural-change/financial-innovation/).

nesses, use of cashless payments improves the likelihood of loan approval, lowers interest rates, and increases loan amounts from FinTech lenders. This paper contributes to the existing literature by highlighting a specific mechanism through which the adoption of electronic payments can spur growth, namely by alleviating credit constraints.

By generating verifiable transaction data, the adoption and use of electronic payments help lenders mitigate information asymmetries in assessing firms' creditworthiness, while also supporting firms in improving operational efficiency and resilience to short-term shocks. Credit providers often use sophisticated credit underwriting models involving the use of structured and unstructured data to quantify credit risk. Integrating alternative data is essential for evaluating individuals without traditional credit histories and for strengthening conventional credit models to improve access for underserved populations and firms (Bollaert et al., 2021; and Klapper, 2024). In this regard, digital technologies improve market efficiency primarily by reducing information asymmetries, critically reducing search and verification costs (Goldfarb and Tucker, 2019). In addition, digital transaction data also represents a valuable source of information to predict creditworthiness for borrowers with no credit history, therefore allowing financial institutions to extend credit to borrowers lacking standard information (Chioda et al., 2024).

Specifically, the usage of electronic payments by firms generates verifiable digital records of both incoming and outgoing transactions, providing valuable information on critical business metrics such as sales revenues and operational costs that previously may have been unavailable to lenders. This, in turn, allows lenders to perform more accurate assessments of the creditworthiness of their potential borrowers, thereby increasing the availability of credit. This effect may be especially relevant in environments where firm information is difficult or costly to obtain, such as in economies with less developed credit infrastructure or when lending to opaque firms like small and medium enterprises (SMEs) or those without audited financial statements.

Building on this theoretical premise, this paper provides empirical evidence on the relationship between electronic payment adoption and extension of credit to firms across

a sample of 101 economies. In doing so, our work contributes to the growing literature examining the informational channel through which electronic payment usage can affect credit provision. Recent empirical evidence supports the mechanism described above. Alok et al. (2024) find that verifiable payment histories generated through India's Fast Payment System contribute to consumer credit expansion by both new and incumbent lenders. Similarly, Aguilar et al. (2024) provide cross-country evidence that electronic payment usage is associated with improved access to credit at the population level. Chioda et al. (2024) offer direct evidence on the predictive power of digital transaction data, showing that information derived from electronic payments effectively predicts borrower creditworthiness, even for individuals with no credit histories.

Our study extends this literature in different directions. First, we provide a comprehensive analysis, examining more than 100 economies across different levels of development. Second, unlike the extant literature, we focus specifically on firm-level credit constraints rather than consumer credit access, allowing us to identify the mechanisms through which electronic payments affect business financing. Third, we distinguish between receiving and making electronic payments, recognizing that these may have different informational content for lenders. We also focus on the link between electronic payment (EP) and financing from the traditional banking sector - more recent literature generally focuses on financing from non-traditional sources such as Fintech firms. Finally, we systematically investigate heterogeneity across firm characteristics and institutional environments to identify the conditions under which electronic payments are most effective at reducing credit constraints.

The remainder of the paper is organized as follows. Section 2 presents the empirical approach. Section 3 discusses the results. Section 4 presents robustness tests and Section 5 concludes.

2. Empirical approach

2.1. Data and variables

We source firm-level information from the World Bank's Enterprise Surveys (ES),[2] a rich dataset that captures a wide range of information on business characteristics, practices, and the environment in which private sector firms operate. The surveys are nationally representative of the non-agriculture formal sector and are collected through face-to-face interviews with business owners or senior managers.

While data is available for more than 300 surveys and 150 economies, we address our analysis to surveys conducted after 2021, when the questionnaire was revised to include, among other questions, information on firms' use of electronic payments.[3] Our final dataset covers 48,581 firms in 101 different economies across different levels of economic development (see Table A.1 in the Appendix A), spanning four years.

Our dependent variable is based on a firm-level indicator of the difficulty of accessing external finance. To construct this indicator, we follow the approach developed by Islam and Rodríguez Meza (2023), which uses firms' responses to questions on their use of external finance and credit application behavior. Three indices capture the severity of the constraint that firms face: Fully Credit Constrained (FCC), Partially Credit Constrained (PCC), or Unconstrained (UC). A firm is FCC if it has no sources of external financing and either did not apply to obtain credit due to expected obstacles or applied and was rejected. PCC measures whether firms have access to external financing but are discouraged from applying for more credit due to perceived obstacles or applied for a loan that was only partially approved. Finally, UC firms are those firms which have adequate access to credit. In this study we will focus on the likelihood of a firm being FCC.

The objective of this study is to relate credit constraints to the use of electronic payments. We distinguish between (i) whether a firm receives or makes electronic payments,

[2] https://www.enterprisesurveys.org

[3] The Enterprise Surveys (ES) questionnaire was revised in coordination with the launch of the Business Ready (B-READY) report (https://www.worldbank.org/en/businessready).

and (ii) the extensive and intensive margins of use, that is, whether the firm uses EP at all, and what share of its transactions are made or received with EP, respectively.

Specifically, the variable *EP_receive* is a binary indicator that equals one if the firm reports receiving payments from customers electronically. Similarly, the variable *EP_make* captures whether the firm pays suppliers or service providers electronically. To capture the intensive margin, we use *EP_receive_share*, which measures the percentage of the firm's sales received electronically, and *EP_make_share*, which measures the percentage of purchases or payments made electronically. These distinctions allow us to separately assess the effects of receiving and making electronic payments, as well as the intensity of their use.

The literature highlights a range of factors—both internal and external to the firm—that contribute to credit constraints. At the micro level, we consider variables capturing a firm's profitability, resilience, and overall business characteristics. Smaller firms tend to face greater financing obstacles, as they are disproportionately affected by financial, legal, and corruption barriers (Beck et al., 2005). Firm age is also a robust and relatively exogenous predictor of financing constraints (Hadlock and Pierce, 2010).

In addition, we control for labor productivity, the firm's main market orientation (local, national, or international), and access to basic infrastructure, including internet connectivity and reliable electricity (proxied by the frequency of power outages). To capture innovation capacity, we include indicators of whether the firm has introduced a new product, process or has invested in research and development (R&D) in the past three years or if the firm maintains a website. Finally, we account for organizational characteristics by including variables indicating whether the top manager is female, whether the firm belongs to a larger business group, and whether it prepares audited financial statements.

To account for structural differences across firms that are not captured by observable characteristics, we include industry and location fixed effects in all regressions. The ES classifies firms according to their main activity in manufacturing, retail trade, wholesale trade, construction, hotels and restaurants, or other services. Location fixed

effects correspond either to the country level or, where data permit, to the sub-national region in which the firm operates. These controls help account for differences in local infrastructure, regulatory enforcement, and market conditions.

2.2. Model

Following existing studies, we relate firm credit constraints to both internal firm characteristics and external environmental factors. The likelihood of being credit constrained is therefore modeled using the following specification:

$$Prob(Credit\,Constraints) = f(Firm, Sector, Country) \tag{1}$$

Within firm-level determinants, our core variables of interest are the adoption of electronic payments ($EP_{adoption}$) and the intensity of usage (EP_{usage}).

We estimate the following logistic regression (logit):

$$P(FCC_{ics}) = F(Z) = \frac{exp(Z_{ics})}{1 + exp^(Z_{ics})} \tag{2}$$

and

$$Z_{ics} = \beta_0 + \alpha EP_{ics} + \beta \mathbf{X}_{ics} + \theta_c + \gamma_s + \zeta_t + \epsilon_{ics} \tag{3}$$

where subscripts i, c, s and t stand for firm, country, industrial sector, and year respectively. F is the logistic cumulative distribution function. $P(FCC_i, c, s)$ represents the probability that a firm is "Fully Credit Constrained". Our variables of interest are the four EP variables that capture the extensive and intensive margins of making or receiving electronic payments.

To test the robustness of the results, we employ a diverse set of sensitivity analyses. First, we examine whether the EP variables are a plausible exogenous proxy for issues

related to information asymmetries. A key challenge in measuring credit constraints is distinguishing firms that are financially constrained due to information frictions from those that lack access to external finance because of inherently high operational risk. This distinction is crucial for policy, as improving access to external capital for the former group could lead to increased production and sales growth (Banerjee and Duflo, 2014). In a second set of tests, we employ a different set of fixed effects to assess whether the results are sensitive to these changes, and we modify our dependent variable to assess different channels by which EP may be affecting credit constraints.

2.3. Stylized facts

Credit constraints affect a significant share of firms in our sample, with 14.78% classified as FCC and an additional 16.23% as PCC. Together, these constrained firms represent over 30% of the private sector firms across the 101 economies surveyed, highlighting the widespread nature of financial access challenges in the global economy.

To better understand the characteristics that distinguish credit-constrained firms from their unconstrained counterparts, and to examine the potential role of EP in this relationship, Table 1 presents detailed summary statistics for our main sample, disaggregated by whether firms are FCC or non-FCC.

EP instruments [4] have achieved widespread penetration among surveyed firms, with approximately 86% of firms receiving EP and 83% of firms using these instruments for outbound payments. These transactions constitute a substantial component of firms' payment operations, accounting for 56% of total sales and 59% of payments made on average. The prevalence of EP adoption underscores the importance of these instruments for the formal economy.

There are sharp disparities when examining EP adoption across firms with different degrees of credit constraints. FCC firms exhibit EP adoption rates approximately 14 percentage points lower than those of UCC or PCC firms, both for making and receiving

[4]The questionnaire lists four electronic payment options: debit cards, credit cards, bank transfers (including online and mobile banking), and other forms such as e-money, e-wallets, and mobile money.

Table 1: Sample descriptive statistics

	All Firms		Firm is FCC		Firm is NOT FCC		Difference	N
Variables	Mean	SD	Mean	SD	Mean	SD		
Firm receives EP?	0.86	0.00	0.75	0.01	0.88	0.00	-0.14***	48,581
Sales with EP (% of total)	0.56	0.00	0.39	0.01	0.59	0.00	-0.2***	48,581
Firm makes EP?	0.83	0.00	0.72	0.01	0.85	0.00	-0.13***	47,283
Payments made with EP (% of total)	0.59	0.00	0.42	0.01	0.62	0.00	-0.2***	47,283
Innovative firm	0.54	0.01	0.34	0.02	0.58	0.01	-0.24***	48,581
Firm has website?	0.61	0.00	0.44	0.01	0.64	0.00	-0.2***	48,581
Female manager	0.20	0.00	0.18	0.01	0.21	0.00	-0.03**	48,581
Multiestablishment	0.11	0.00	0.08	0.01	0.11	0.00	-0.03***	48,581
Firm does not face internet outages	0.61	0.00	0.54	0.01	0.62	0.00	-0.08***	48,581
Firm does not face power outages	0.57	0.00	0.50	0.01	0.58	0.00	-0.08***	48,581
Annual Sales ('000 USD PPP)	11,725	1,135	3,311	927	13,185	1,347	-9874***	48,581
Labor Productivity ('000 USD PPP)	3.98	0.01	3.04	0.04	4.15	0.01	-1.10***	48,581
Number of workers	35.94	0.80	21.00	0.46	38.53	0.94	-17.54***	48,581
Age of the firm	17.34	0.11	14.20	0.30	17.88	0.13	-3.68***	48,581
Firm mainly sells at local level	0.47	0.00	0.57	0.01	0.45	0.00	0.12***	48,581
Firm mainly sells at national level	0.46	0.00	0.39	0.01	0.47	0.01	-0.08***	48,581
Firm mainly sells at intern. level	0.07	0.00	0.04	0.00	0.08	0.00	-0.04***	48,581
Audited Financial Statements?	0.44	0.00	0.32	0.01	0.46	0.00	-0.14***	48,581
N	48,581		6,407		42,174			

Note: Averages for 101 economies using sampling weights. FCC: Firm is fully credit constrained. Not FCC: firm is not fully credit constrained. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

payments. The intensity of usage follows a similar pattern: only 39% of sales and 42% of payments made use EP, compared to 59% and 62% respectively for non-FCC firms.

The data also reveal that FCC firms are less digitally integrated and innovative. Only 44% have a corporate website compared to 64% of non-FCC firms, and just 34% report introducing new products or processes in the past three years, compared to 58% among their non-FCC peers. Firm size and productivity are also negatively correlated with credit constraint status. FCC firms employ on average 21 workers, which is approximately 45% lower than non-FCC firms. This size differential extends to sales, where FCC firms have annual sales of $3.3 million (USD PPP-adjusted), approximately 75% lower than the $13.2 million average for non-FCC firms.

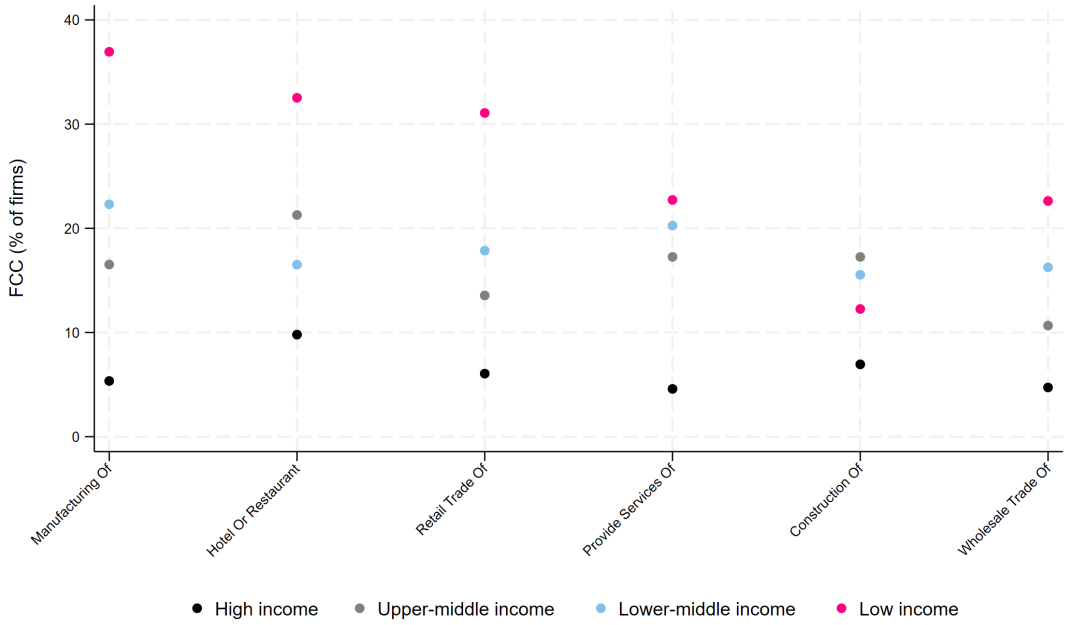
Labor productivity follows a similar trajectory, with FCC firms annually selling on average $3,040 per worker compared to $4,150 for non-FCC firms (USD PPP-adjusted), suggesting that credit constraints may restrict both scale and efficiency improvements or, alternatively, that smaller and less efficient firms are less likely to be able to be adequately serviced by creditors.

The geographic scope of the main market also differs across credit constraint categories. FCC firms concentrate predominantly in local markets, with 57% focusing on

local sales compared to 45% for non-FCC firms. Conversely, participation in international markets remains limited among FCC firms at 4%, half the rate observed for unconstrained firms.

Taken together, these stylized facts paint a consistent picture: credit-constrained firms lag behind their unconstrained counterparts across multiple dimensions of performance and technology adoption. All differences between FCC and non-FCC firms reported in Table 1 are statistically significant at the 1% level.

Figure 1: Firms credit constraints vary by industry and income group



Note: The figure shows the average percentage of firms that are credit constrained (Y axis) by country grouping according to the level of economic activity.

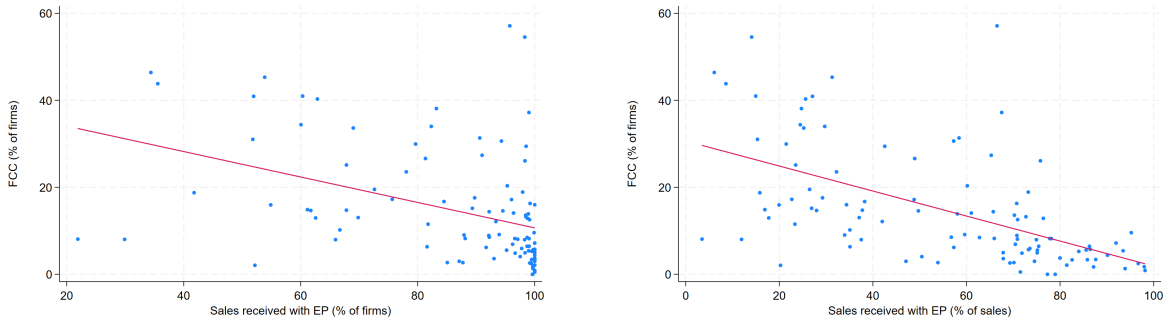
Some of the observed heterogeneity may be explained by variation across industries and economies. Figure 1 reveals that the incidence of FCC firms varies substantially across both dimensions. Regarding industries, manufacturing, retail trade and accommodation sectors exhibit relatively elevated rates of credit constrained firms, while construction shows the lowest incidence. Across income group levels, low-income countries have the highest percentage of firms that are credit constrained across sectors, except for the construction sector.

As reported in Table 1, there appears to be a strong negative association between the use of electronic payments and FCC. This correlation may be strongly driven by country-level determinants. Figure 2 collapses data for sales received using electronic payments at the economy level and shows a substantial negative correlation between EP adoption and credit constraints after controlling for economy-level fixed effects. This negative correlation exists both at the intensive and extensive margins. The strength of these correlations provides suggestive evidence that payment digitalization may play a meaningful role in credit market access, a relationship we explore formally in the next section.

Figure 2: Partial correlation between firm credit constraints and receiving electronic payments

(a) FCC and frequency of receiving EP

(b) FCC and intensity of receiving EP

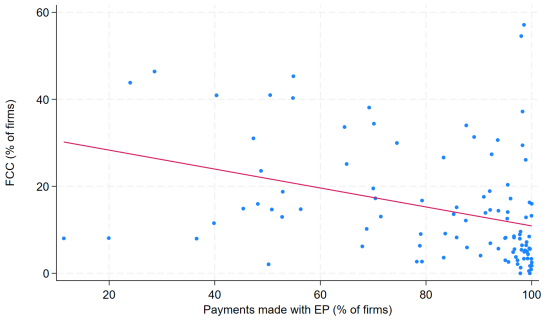


Note: The figure shows for each country the percentage of firms that are fully credit constrained (FCC) and the intensive (panel A) and extensive margin of receiving electronic payments (panel B). Each dot represents a country.

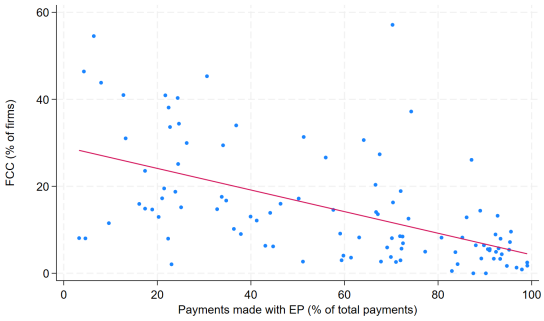
Figure 3 provides supportive evidence for the importance of considering separately making and receiving electronic payments. As explained above, we argue that tracing how sales are received helps credit institutions in retrieving important business information that is often difficult to retrieve especially in developing countries.

Figure 3: Partial correlation between firm credit constraints and making electronic payments

(a) FCC and frequency of making EP



(b) FCC and intensity of making EP



Note: The figure shows for each country the percentage of firms that are fully credit constrained (FCC) and the intensive (panel A) and extensive margin of making electronic payments (panel B). Each dot represents a country.

3. Results

Our primary goal is to investigate whether the adoption and use of electronic payments is associated with lower credit constraints. Table 2 reports the average marginal effects obtained after estimating Equation 2. On average, the probability of being credit constrained decreases by 3.3 percentage points if a firm receives payments through electronic means (Table 2, column 1). This result is economically meaningful, representing approximately 22% of the sample mean (see Table B.1 in Appendix B). Similarly, the magnitude and sign of the relation between the intensity of the use of EP and FCC is in line with the extensive margin (Table 2, column 2). In ancillary regressions not shown in the paper we run the model by including simultaneously both variables related to receiving EP and find that the extensive margin, more than the intensity of use, has a stronger negative relation with FCC. Next, we find a statistically insignificant relation between making payments through EP and firms credit constraints (Table 2, column 3). The intensive margin of making EP payments is also weakly and negatively related to FCC (Table 2, column 4) but it becomes statistically insignificant when considering both the intensive and extensive margin of making payments at the same time.[5]

The differences in the coefficients of payments made and payments received reveal

[5]Results are available from the authors upon request.

important insights about the informational content of electronic payment data for credit assessment. Receiving electronic payments provides information that is particularly relevant for credit evaluation, possibly because these transactions offer lenders with direct, verifiable evidence of firm sales revenues, and therefore, the cash flow generation capacity of a firm. In contrast, outgoing electronic payments, while providing information about supplier relationships and operational expenditure appear to be less useful for credit evaluation purposes.

Estimates summarized in Columns (5) and (6) of Table 2 corroborate the finding that the relation between FCC and EP is stronger when we consider the variable receiving electronic payments. For this reason, in subsequent sections we will focus on this relation for the analysis of heterogeneity and some robustness tests. In general, the estimates of the other control variables are in line with the extant literature. A robust negative relationship is shown between credit constraint and firm innovation, labor productivity, size and whether the financial statements are externally audited. Overall, in line with recent evidence (for example, Ghosh et al. (2025) for small businesses in India), results in Table 2 indicate that the signals derived from electronic payments complement other indicators of borrower quality.

3.1. Heterogeneous Effects: The Role of Firm Characteristics

We characterize the results in Section 3 and delve into heterogeneity at the firm level. Table 3 presents the results based on the same specification as Column (1) of Table 2, focusing, for ease of exposition, on the variable most strongly associated with FCC. It shows the discrete change in the predicted outcome associated with receiving electronic payments, computed separately for each category of the variable displayed in Table 3. This allows us to compare how the marginal effect of receiving electronic payments varies across different levels of that variable.

We report the relation for those variables that were significantly related to FCC in Table 2 and add age since previous literature identifies this variable as a strong predictor of financial constraints (Hadlock and Pierce, 2010; Whited and Wu, 2006). In each

Table 2: Use of electronic payments diminishes with credit constraints

Dependent Variable = Firm is Fully Credit Constrained	(1)	(2)	(3)	(4)	(5)	(6)
Firm receives EP?	-0.033***				-0.033***	
	(0.011)				(0.013)	
% of sales received with EP		-0.037***				-0.034**
		(0.012)				(0.013)
Firm makes EP?			-0.014		0.010	
			(0.010)		(0.013)	
% of payments made with EP				-0.020*		-0.006
				(0.011)		(0.013)
Innovation in process	-0.032***	-0.033***	-0.033***	-0.033***	-0.033***	-0.033***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Innovation in product	-0.031**	-0.031***	-0.031**	-0.031**	-0.030**	-0.031**
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Innovation process, product, and spending in R&D	-0.045**	-0.046**	-0.047**	-0.047**	-0.045**	-0.046**
	(0.019)	(0.019)	(0.020)	(0.020)	(0.020)	(0.020)
Firm has website?	0.004	0.004	0.002	0.003	0.004	0.004
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Female manager	-0.012	-0.012	-0.011	-0.011	-0.011	-0.010
	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)
Multiestablishment	-0.017	-0.018	-0.016	-0.015	-0.015	-0.016
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Firm does not face internet outages	0.007	0.007	0.006	0.007	0.007	0.007
	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)
Firm does not face power outages	0.006	0.006	0.005	0.005	0.005	0.005
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Main product of firm sold in national market	-0.001	-0.001	-0.006	-0.005	-0.002	-0.002
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Main product of firm sold in international markets	0.008	0.013	0.009	0.010	0.009	0.013
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
Labor productivity (log, '000 USD PPP)	-0.012***	-0.011***	-0.012***	-0.012***	-0.012***	-0.012***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Number of workers (log)	-0.041***	-0.041***	-0.040***	-0.040***	-0.041***	-0.041***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Age of the firm	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Audited Financial Statements?	-0.021***	-0.022***	-0.020***	-0.020***	-0.020***	-0.020***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Observations	48,581	48,581	47,773	47,773	47,283	47,283
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table reports the average marginal effects obtained after estimating Equation 2. Base category for the main product of firm sold is local market. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

column, a distinct variable appearing in Table 2 is substituted with the correspondent categorical variable. That is size is substituted with a categorical variable taking the value of 1 if small, 2 if medium, and 3 if large.[6] In Column (2), the age variable is replaced with a categorical measure identifying whether a firm is a start-up (less than 1 year), young (2 to 10 years), or mature (more than 10 years). In Column (3), the

[6]A firm is classified as small if the number of workers is between 5 and 19, medium between 20 and 99, or large for more than 100.

Table 3: Heterogeneous firm effects

Dependent Variable = Firm is Fully Credit Constrained	(1)	(2)	(3)	(4)	(5)
Small	-0.040***				
	(0.012)				
Medium	-0.030***				
	(0.009)				
Large	-0.018***				
	(0.006)				
Age (less than 1 year or less)		-0.044***			
		(0.014)			
Age (between 2 and 10 years)		-0.038***			
		(0.012)			
Age (more than 10 years)		-0.029***			
		(0.010)			
No innovation			-0.037***		
			(0.012)		
Innovation in 1 element			-0.026***		
			(0.009)		
Innovation in 2 elements			-0.023***		
			(0.008)		
Innovation process, product, and spending in R&D			-0.016***		
			(0.006)		
1st Quartile Labor Productivity ('000 USD PPP)				-0.046***	
				(0.015)	
2nd Quartile Labor Productivity ('000 USD PPP)				-0.034***	
				(0.011)	
3rd Quartile Labor Productivity ('000 USD PPP)				-0.025***	
				(0.008)	
4th Quartile Labor Productivity ('000 USD PPP)				-0.019***	
				(0.006)	
Financial Statements Audited (No)					-0.038***
					(0.012)
Financial Statements Audited (Yes)					-0.026***
					(0.009)
Observations	48,581	48,581	48,581	48,581	48,581
Control Variables	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes

Note: This table reports the average marginal effects obtained after estimating Equation 2. The discrete change of receiving electronic payments is computed for each variable. In each column the relevant variable appearing in Equation 2, that is size, age, innovation and productivity, is substituted with a categorical variable. The remaining variables are the same as reported in Table 2. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

innovation variable is replaced with a categorical measure indicating whether the firm introduced no innovation, or one, two, or all three types: product, process, and research and development expenditures-related innovation. In Column (4), labor productivity is represented by categorical variables indicating the quartile in which a firm falls within the overall productivity distribution.

Table 3 provides strong evidence of the information channel explored in this paper. The marginal effect of receiving electronic payments is more pronounced for smaller

firms, which typically suffer from limited and less reliable information, making them more difficult for lenders to assess (Table 3, Column 1). Similarly, newly formed firms often lack history and information that is valuable in terms of their credit worthiness assessment and credit availability (Petersen and Rajan, 1994; Beck et al., 2008). By the same token, firms that do not engage in innovative activities often lack the organizational and informational capacities to transparently document and communicate the structure, governance, and profitability of their operations. This informational opacity increases asymmetries between firms and external financiers, thereby raising the perceived risk of lending and limiting access to credit. This is highlighted by the average marginal effect of non-innovative firms, which is nearly twice as large as that of the firms that innovate the most (Table 3, Column 3). The results on firm productivity confirm the marginal effect of receiving electronic payments is larger for the least efficient and productive firms (Table 3, Column 4). This finding reinforces the notion that electronic payments serve as a valuable source of information, particularly for firms with lower efficiency and profitability. Finally, consistent with the view that the adoption and use of electronic payments alleviate credit constraints via the information channel, firms without audited financial statements benefit the most from financial digitalization (Table 3, Column 5). Overall, the results in Table 3 provide robust evidence of a strong negative association between the use of electronic payments and firm credit constraints.

3.2. Heterogeneous Effects: Quality of the Business Environment

The characteristics of a country's legal and financial systems play a critical role in shaping firms' ability to access external financing for growth (Demirgüç-Kunt and Maksimovic, 1998). In this regard, credit markets may interact with the mechanisms through which EP usage alleviates credit constraints. For example, Credit Information Systems are particularly important as they reduce information asymmetries by aggregating and facilitating access to data relevant for assessing firms' creditworthiness. By making firms less informationally opaque, these systems facilitate credit provision through traditional lending channels. As previously discussed, EP usage operates through a similar

mechanism, generating alternative data trails that reduce information asymmetries by providing verifiable transaction data.

Since both mechanisms operate through reducing information frictions, a natural question of substitutability arises. In economies with well-developed credit information systems, one would expect that the marginal value of electronic payment data should be less, because lenders already possess firms' credit information through Credit Information Systems. To test this hypothesis, we employ measures of credit information availability at the economy level, as measured by the World Bank Business Ready Indicators that are relevant for credit information.

Business Ready provides two indicators for credit information. The first, *The Operation of Credit Bureaus and Registries*, assesses the quality of credit information systems by measuring the coverage, comprehensiveness, and frequency of data updates, among other key features. The second, *The Accessibility of Information in Credit Infrastructure*, takes a broader perspective by incorporating not only the functioning of credit bureaus and registries but also the existence and design of collateral registries. Together, these indicators capture the depth and accessibility of credit information within an economy. Both are scored on a 0–100 scale, with higher values reflecting more developed credit information systems.

Figure 4 presents the discrete change in the predicted outcome associated with receiving electronic payments, computed separately for three groups of economies. We divide the sample into equal-width intervals based on the range of the two Business Ready indicators. The first group includes economies in the bottom third of the score distribution (representing weak credit information frameworks), the second group contains economies in the middle, and the third group comprises economies in the top of the distribution (representing well developed systems).

Results show that the marginal effect of the introduction of electronic payments is substantially larger in economies where Credit Information Systems are less developed, providing support to our hypothesis that digital transaction trails are most valuable in informationally opaque environments where traditional credit reporting mechanisms do

not serve borrowers adequately.

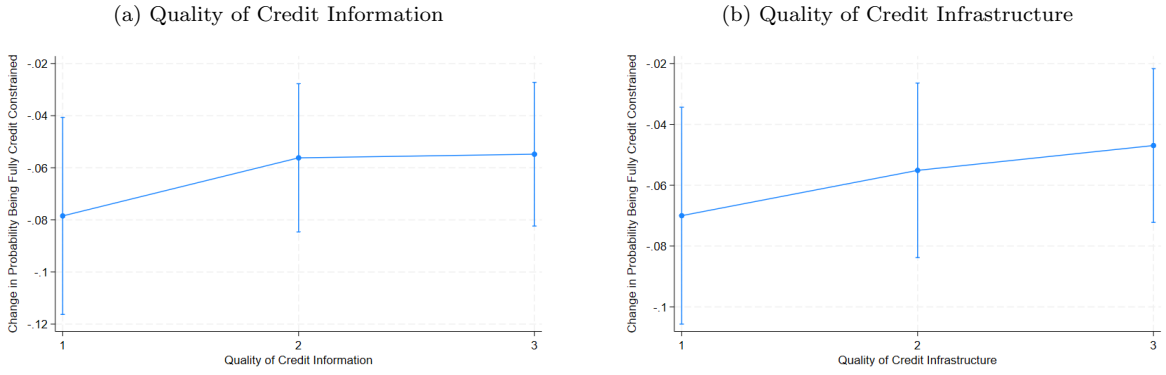
3.3. Heterogeneous Effects: Aggregate Determinants

To examine how the relationship between electronic payments and credit constraints varies across industry and economy levels, we extend our analysis to consider heterogeneity at the aggregate level. Table 4 presents the marginal effects of receiving electronic payments computed separately for different industries, income classifications, and levels of financial development.

Column (1) of Table 4 shows that results remain relatively consistent across different industry sectors, with marginal effects ranging from -2.7 to - 3.7 percentage points. This suggests that the benefits of electronic payments for alleviating credit constraints are not concentrated in specific industry sectors and represent a general phenomenon.

Column (2) reveals a clear inverse relationship between a country's income level and the magnitude of the effect: the marginal effects for low-income economies are nearly three times larger than those for high-income economies. This result aligns with previous evidence indicating that the strength of credit-information institutions (such as public registries and private credit bureaus) increases with economic development—being weaker and less prevalent in poorer countries—and is positively associated with deeper private credit markets (Jappelli and Pagano, 2002; Djankov et al., 2007). The magnitude

Figure 4: Marginal effect of receiving electronic payments by quality of business environment



Note: The figure shows the average marginal effects computed using the specification in Table 2 except for the country fixed effects substituted by the operation of credit bureaus and registries and the accessibility of information in credit infrastructure indicator in panel a) and b) respectively.

Table 4: Heterogeneous aggregate effects

Dependent Variable = Firm is Fully Credit Constrained	(1)	(2)	(3)	(4)
Accommodation and food service	-0.036***			
	(0.012)			
Construction	-0.027***			
	(0.009)			
Information and communication	-0.030***			
	(0.010)			
Manufacturing	-0.036***			
	(0.012)			
Other service activities	-0.029***			
	(0.010)			
Retail Trade	-0.035***			
	(0.011)			
Transportation and storage	-0.031***			
	(0.010)			
Wholesale Trade	-0.028***			
	(0.009)			
Low income		-0.055***		
		(0.017)		
Lower middle income		-0.039***		
		(0.013)		
Upper middle income		-0.034***		
		(0.011)		
High Income		-0.018***		
		(0.006)		
1st Quartile Financial Development Index			-0.056***	
			(0.016)	
2nd Quartile Financial Development Index			-0.034***	
			(0.010)	
3rd Quartile Financial Development Index			-0.029***	
			(0.009)	
4th Quartile Financial Development Index			-0.021***	
			(0.007)	
1st Quartile Shadow Economy Activity				-0.015**
				(0.006)
2nd Quartile Shadow Economy Activity				-0.023***
				(0.009)
3rd Quartile Shadow Economy Activity				-0.036***
				(0.013)
4th Quartile Shadow Economy Activity				-0.042***
				(0.015)
Observations	48,581	48,581	47,230	44,931
Control Variables	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes

Note: This table reports the average marginal effects obtained after estimating Equation 2. The discrete change of receiving electronic payments is computed for each variable. Standard errors in parentheses. In column (3) and (4) the number of observations is lower as data is not available for all the countries in the sample for the financial development index and the measure of the shadow economy activity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

of the marginal effect further suggests that the use of electronic payments may serve as an alternative source of borrower information for lenders, helping to mitigate adverse selection, expand lending, and facilitate more effective monitoring.

Column (3) documents the differentiated effect by quartiles of the IMF's Financial Development Index (Sahay et al., 2015). Similar to the results in Column (2), marginal effects tend to be much larger for firms in economies with lower levels of financial development.

Column (4) of Table 4 provides evidence of the mediating role played by the size of informal activities. The extent of the shadow economy is proxied by the share of a country's output generated informally, following the measure developed by Medina and Schneider (2018), with data available up to 2020 from Elgin et al. (2021). To assess the mediating effect of informality on the relationship between credit constraints and the use of electronic payments, we focus on quartiles of the distribution of informal activity as per year 2020. A larger informal sector is typically associated with economic inefficiency, as most informal firms remain small and have limited access to financial services (La Porta and Shleifer, 2014; Loayza, 2018). The results in Column (4) suggest that the benefits of adopting electronic payments are larger in more informal economies. This pattern is consistent with the information channel: in economies with large informal sectors, financial records may be less informative because firms often misrepresent earnings or costs to avoid taxes or regulatory scrutiny, rendering them more opaque to lenders (Gatti and Honorati, 2008). In such environments, the transaction data generated by electronic payments may serve as a substitute for less reliable traditional sources of credit information.

Overall, the estimates in Table 4 indicate that the informational trail generated by electronic payment usage is particularly valuable in economies characterized by limited financial infrastructure, a large informal sector, and underdeveloped credit markets. In such environments, where conventional mechanisms for assessing creditworthiness are constrained, the adoption of digital payment technologies appears to yield greater benefits by enhancing transparency, mitigating information asymmetries, and improving

firms' operational efficiency.

4. Testing the link between EP and credit constraints

Establishing a causal effect from the use of electronic payments to access to finance is challenging due to potential endogeneity, and our baseline estimates may be biased for two reasons.

First, reverse causality is a concern. Firms with better access to external finance have more resources to invest in payment infrastructure and can more easily absorb the fixed costs of adopting EP. Additionally, firms with existing credit relationships may receive payment services from the same financial institutions that provide their loans. Consequently, part of the observed correlation may be caused by credit access facilitating EP adoption rather than the reverse. Second, omitted variable bias may affect our estimates because unobserved firm characteristics could drive both EP adoption and credit constraints simultaneously. For example, the quality of management is difficult to be fully captured in survey data but likely influences both outcomes. Similarly, firms with strong growth prospects may adopt electronic payments while also being more attractive to lenders.

While we cannot fully rule out these endogeneity concerns in the current version of the paper, we report a series of tests that strengthen confidence in our baseline findings. First, we examine whether electronic payments provide information relevant for assessing creditworthiness beyond what is captured by standard firm characteristics. Second, we explore sensitivity to alternative specifications of the dependent variable and fixed effects structure.

We first focus on the question of whether digital payments may contribute some meaningful additional information to assess the creditworthiness of firms. Specifically, we attempt to isolate the relation between our main variable of interest and any residual determinant of firm FCC. We employ a two-step approach. In the first step, we estimate the predicted probability of being FCC ($\widehat{FCC}$) using the same explanatory variables as in equation 3 but excluding the EP variables. As previously noted, variables such as

firm size and age are included among the regressors, as they have been widely recognized in the literature as reliable predictors of financial constraints (among many others, see Hadlock and Pierce, 2010; Whited and Wu, 2006). Their inclusion helps mitigate concerns about potential misclassifications.

As a next step, we construct the "unexplained credit constraint" as the difference between the predicted probability of being FCC ($\widehat{FCC}$) and FCC, setting this residual to zero for firms that are not credit constrained ($\widehat{UCC_{residual}}$). This residual component captures all factors not explained by firm, sector, or country fundamentals (for example, insufficient credit supply) and, crucially, it should reflect the adverse impact of asymmetric information on credit provision. A high value indicates that a firm is constrained despite having characteristics that would typically predict access to credit.

We then proceed to assess the correlation between this residual and our electronic payment variables. If EP lessens information asymmetries, we would expect firms that adopt EP to exhibit lower unexplained credit constraints, as, for example, the transaction data they generate helps lenders assess their creditworthiness beyond what is captured by standard firm characteristics. The estimates in Table 5 confirm this prediction and reveal that firms using EP show lower unexplained credit constraints, suggesting that EP provide additional information relevant for credit assessment.

In Table 6 we report robustness checks using alternative specifications. Column (1) separates the effect of receiving electronic payments by the instrument type that accounts for the largest share of EP received as reported by each firm. We distinguish between card payments, bank transfers, and other electronic payment instruments (including mobile money and e-money). The results reveal substantial heterogeneity: while bank transfers and other payment methods are significantly associated with lower credit constraints, card payments show no significant effect. This pattern is consistent with the information channel and the heterogeneity documented in Tables 3 and 4. Card payments are substantially more prevalent in high-income economies,[7] which are already

[7]Cards are the primary instrument for receiving EP for 25 percent of firms that receive EP in high-income economies, compared to just 4.1 percent in low-income economies.

Table 5: Firm hidden credit constraint

Dependent Variable = Firm Residual Credit Constraint	(1)	(2)	(3)	(4)
Firm receives EP? (%) = 1	-8.097***			
	(0.852)			
Percentage of payments received using e-payments		-10.216***		
		(0.688)		
Firm makes EP? (%) = 1			-6.182***	
			(0.742)	
Payments made using e-payments (%)				-8.992***
				(0.644)
Observations	48,581	48,581	47,283	47,283

Note: This table reports the average marginal effects obtained in two stages. In the first stage, the probability of being financially constrained is related to the set of standard determinants as described in Equation 2 except the variables capturing the use of electronic payments. In the second stage, this estimated probability of being financially constrained, expressed on the range 0 to 1, is related to each variable measuring the use of electronic payments. As reported in the table, in each regression we do not include the stage-one determinants, namely the firm controls (e.g., size), and the country and industry fixed effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

well served by credit information systems and where the marginal informational value of transactional data may be lower.

We also examine the association between receiving electronic payments (EP) and different categories of credit constraints. Following Islam and Rodríguez Meza (2023), we distinguish among three mutually exclusive credit-constraint statuses: Fully Credit Constrained (FCC), Partially Credit Constrained (PCC), and Unconstrained (UC). This classification allows us to assess whether the relationship between digital payment usage and credit access varies with the severity of financing constraints. Column (2) replaces the baseline dependent variable with an indicator for a firm being unconstrained (UC) and yields a positive and statistically significant coefficient, indicating that EP adoption is systematically associated with a higher likelihood of being unconstrained, consistent with improved access to credit across alternative outcome definitions.

Column (3) reports estimates from an ordered logit model where we construct a single index that brings together the information of the three indexes calculated in Islam and Rodríguez Meza (2023). The estimated marginal effects are statistically significant across all three categories. Receiving electronic payments reduces the probability of being

Table 6: Robustness test for alternative specifications

Dependent variable:	FCC	UC	Ordered logit	Perception
	(1)	(2)	(3)	(4)
Firm receives EP? (%)=1		0.024*		-0.021
		(0.014)		(0.017)
Cards	-0.007			
	(0.014)			
Bank transfer	-0.036***			
	(0.012)			
Other	-0.038***			
	(0.013)			
EP - P(Constrained)			-0.024***	
			(0.009)	
EP - P(Partially constrained)			-0.014***	
			(0.005)	
EP - P(Unconstrained)			0.038***	
			(0.014)	
Observations	48,267	48,581	48,581	47,918
Control Variables	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes

Note: This table reports robustness checks using alternative specifications of the dependent variable and sample. Columns (2) and (4) report average marginal effects of firms receiving electronic payments replacing the dependent variable with a variable capturing that firms are not credit constrained (Column 2), or with a variable measuring whether finance is classified as a severe or very severe obstacle to the current operations of this establishment (Column 4). Column (1) reports marginal effects for different payment instruments (card, bank-related, other). Column (3) estimates an ordered logit model where the dependent variable takes the value 1 (constrained), 2 (partially constrained), and 3 (unconstrained). The three rows in the statistics panel report the marginal effects of receiving electronic payments on the probability of being in each category. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

fully credit constrained (FCC) and partially credit constrained (PCC) by 2.4 and 1.4 percentage points, respectively, while increasing the probability of being unconstrained by 3.8 percentage points. The larger magnitude of the effect for FCC firms suggests that the association between EP usage and credit access is stronger for firms facing more severe financing constraints, where information frictions are likely to be more pronounced.

Column (4) uses an alternative dependent variable capturing whether the firm perceives access to finance as a major or very severe obstacle to its operations. Unlike

our baseline measure, which is based on actual credit application behavior and outcomes, this indicator reflects subjective perceptions. The coefficient is not statistically significant, suggesting that the effect of EP runs through actual credit access rather than perceived financing obstacles, reinforcing the notion that EP is relevant for lending decisions because it provides concrete information to creditors.

Finally, Table B1 in Appendix B shows that our estimates remain stable across a range of alternative specifications, including models with more granular industry and location fixed effects that help account for unobserved heterogeneity potentially omitted from the baseline specification, as well as a specification that excludes control variables. The consistency of the estimated coefficients across these specifications provides support for the robustness of our main results to unobserved confounding factors.

The results in this section provide further support for our baseline findings. The association between electronic payments and credit constraints is robust to alternative definitions of the dependent variable, different measures of electronic payment usage, a diverse set of fixed-effects, and the exclusion of control variables. Moreover, the analysis of the residual component of credit constraints—net of observable firm fundamentals—suggests that electronic payments convey information relevant for credit assessment beyond what is captured by standard firm characteristics. Although this version of the paper cannot fully rule out endogeneity concerns, the consistency of the results across specifications lends support to the interpretation that electronic payments are associated with lower credit constraints through the mitigation of information asymmetries between firms and lenders.

5. Conclusion

Easing credit constraints is critical for promoting private sector development and supporting firm growth. This study shows that the use of electronic payments is an important determinant of firms' access to credit. Drawing on data from 101 economies at different stages of economic development, we highlight three main findings.

First, payment digitalization plays a critical role in alleviating credit constraints,

particularly for firms most affected by information frictions. Second, the broader quality of the operating environment shapes the marginal contribution of electronic payment adoption: firms in economies with lower levels of financial development, weaker credit information infrastructure and greater size of the informal economy benefit the most from adopting electronic payments. Third, digital transactions provide an alternative source of information for lenders, thereby expanding opportunities for financial access and inclusion.

Crucially, since our findings suggest that the reduction of credit constraints associated with EP is driven by making more information available for lenders rather than by affecting the underlying credit risk of firms, it follows that EP adoption allows lenders to better distinguish among firms, improving the efficiency of credit allocation in the economy by financing more profitable ventures, which in turn may enhance aggregate productivity.

Taken together, these findings support the view that electronic payments help reduce information asymmetries between firms and lenders, thereby improving lending opportunities. From a policy perspective, promoting the adoption of electronic payments and strengthening the supporting financial and informational infrastructure can play a pivotal role in enhancing credit access, particularly in developing economies. This underscores the importance of integrating digital finance initiatives into broader strategies for financial inclusion, financial sector development, and private sector growth.

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Appendix A. Sample description

Table A.1: Sample by economy

Economy	Obs	Income Group	Region
Angola	382	Lower middle income	Sub-Saharan Africa
Armenia	312	Upper middle income	Europe & Central Asia
Azerbaijan	178	Upper middle income	Europe & Central Asia
Bahrain	95	High income	Middle East & North Africa
Bangladesh	530	Lower middle income	South Asia
Barbados	118	High income	Latin America & Caribbean
Belgium	74	High income	Europe & Central Asia
Benin	334	Lower middle income	Sub-Saharan Africa
Bhutan	150	Lower middle income	South Asia
Bosnia and Herzegovina	277	Upper middle income	Europe & Central Asia
Botswana	574	Upper middle income	Sub-Saharan Africa
Bulgaria	654	High income	Europe & Central Asia
BurkinaFaso	368	Low income	Sub-Saharan Africa
Cabo Verde	163	Lower middle income	Sub-Saharan Africa
Cambodia	517	Lower middle income	East Asia & Pacific
Cameroon	586	Lower middle income	Sub-Saharan Africa
Canada	874	High income	North America
Central African Republic	95	Low income	Sub-Saharan Africa
Chad	155	Low income	Sub-Saharan Africa
China	1796	Upper middle income	East Asia & Pacific
Colombia	879	Upper middle income	Latin America & Caribbean
Congo, Rep.	286	Lower middle income	Sub-Saharan Africa
Costa Rica	276	Upper middle income	Latin America & Caribbean
Croatia	452	High income	Europe & Central Asia
Cyprus	245	High income	Europe & Central Asia
Czechia	231	High income	Europe & Central Asia
Côte d'Ivoire	524	Lower middle income	Sub-Saharan Africa
Congo, Dem. Rep.	967	Low income	Sub-Saharan Africa
Ecuador	332	Upper middle income	Latin America & Caribbean
ElSalvador	528	Upper middle income	Latin America & Caribbean
Equatorial Guinea	164	Upper middle income	Sub-Saharan Africa
Estonia	339	High income	Europe & Central Asia
Eswatini	149	Lower middle income	Sub-Saharan Africa
Gambia, The	155	Low income	Sub-Saharan Africa
Georgia	531	Upper middle income	Europe & Central Asia
Ghana	606	Lower middle income	Sub-Saharan Africa
Greece	586	High income	Europe & Central Asia
Hong Kong SAR China	149	High income	East Asia & Pacific
Hungary	812	High income	Europe & Central Asia
Iceland	350	High income	Europe & Central Asia
Indonesia	610	Upper middle income	East Asia & Pacific
Iraq	375	Upper middle income	Middle East & North Africa
Ireland	579	High income	Europe & Central Asia
Italy	1133	High income	Europe & Central Asia
Jamaica	158	Upper middle income	Latin America & Caribbean
Jordan	561	Lower middle income	Middle East & North Africa
Kazakhstan	991	Upper middle income	Europe & Central Asia
Korea, Rep.	1447	High income	East Asia & Pacific
Kyrgyz Republic	310	Lower middle income	Europe & Central Asia
Lao PDR	350	Lower middle income	East Asia & Pacific
Latvia	256	High income	Europe & Central Asia
Lesotho	133	Lower middle income	Sub-Saharan Africa
Madagascar	206	Low income	Sub-Saharan Africa
Malaysia	849	Upper middle income	East Asia & Pacific
Mali	342	Low income	Sub-Saharan Africa
Mauritius	303	Upper middle income	Sub-Saharan Africa
Mexico	925	Upper middle income	Latin America & Caribbean
Moldova	144	Upper middle income	Europe & Central Asia
Montenegro	140	Upper middle income	Europe & Central Asia
Morocco	256	Lower middle income	Middle East & North Africa
Namibia	200	Upper middle income	Sub-Saharan Africa
Nepal	570	Lower middle income	South Asia
New Zealand	288	High income	East Asia & Pacific
North Macedonia	338	Upper middle income	Europe & Central Asia
Pakistan	1039	Lower middle income	South Asia
Papua New Guinea	79	Lower middle income	East Asia & Pacific
Paraguay	342	Upper middle income	Latin America & Caribbean
Peru	720	Upper middle income	Latin America & Caribbean
Philippines	692	Lower middle income	East Asia & Pacific
Poland	1441	High income	Europe & Central Asia
Portugal	991	High income	Europe & Central Asia
Romania	934	High income	Europe & Central Asia
Rwanda	340	Low income	Sub-Saharan Africa
Samoa	142	Lower middle income	East Asia & Pacific
Senegal	576	Lower middle income	Sub-Saharan Africa
Serbia	412	Upper middle income	Europe & Central Asia
Seychelles	74	High income	Sub-Saharan Africa
Sierra Leone	187	Low income	Sub-Saharan Africa
Singapore	608	High income	East Asia & Pacific
Slovak Republic	444	High income	Europe & Central Asia
Slovenia	393	High income	Europe & Central Asia
South Sudan	150	Low income	Sub-Saharan Africa
Spain	1360	High income	Europe & Central Asia
Sweden	544	High income	Europe & Central Asia
Taiwan China	546	High income	East Asia & Pacific
Tajikistan	301	Lower middle income	Europe & Central Asia
Tanzania	453	Lower middle income	Sub-Saharan Africa
Timor-Leste	70	Lower middle income	East Asia & Pacific
Togo	138	Low income	Sub-Saharan Africa
Tonga	137	Upper middle income	East Asia & Pacific
Trinidad and Tobago	82	High income	Latin America & Caribbean
Tunisia	469	Lower middle income	Middle East & North Africa
Türkiye	689	Upper middle income	Europe & Central Asia
Turkmenistan	253	Upper middle income	Europe & Central Asia
United Kingdom	963	High income	Europe & Central Asia
United States	2429	High income	North America
Uruguay	345	High income	Latin America & Caribbean
Uzbekistan	748	Lower middle income	Europe & Central Asia
Vanuatu	46	Lower middle income	East Asia & Pacific
Viet Nam	897	Lower middle income	East Asia & Pacific
West Bank And Gaza	290	Lower middle income	Middle East & North Africa

Table A.2: Descriptive statistics

Variables	Mean	SD	Min	Max	N
Firm is fully credit constrained	14.780	0.332	0.000	100.000	48,581
Firm receives EP? (%)	0.864	0.003	0.000	1.000	48,581
Percentage of payments received using e-payments	0.560	0.003	0.000	1.000	48,581
Firm makes EP? (%)	0.832	0.003	0.000	1.000	47,283
Payments made using e-payments (%)	0.593	0.003	0.000	1.000	47,283
Innovative process	0.171	0.003	0.000	1.000	48,439
Innovation product	0.259	0.004	0.000	1.000	48,581
Spent in R&D	0.112	0.003	0.000	1.000	48,581
Has a website	0.606	0.004	0.000	1.000	48,581
Femal Top Manager	0.201	0.004	0.000	1.000	48,581
Multiestablishment firm	0.110	0.003	0.000	1.000	48,581
Firm does not face internet outages	0.605	0.004	0.000	1.000	48,581
Firm does not face power outages	0.569	0.004	0.000	1.000	48,581
Anual Sales ('000 USD PPP)	11,725	1,135	0.000	8.11e+07	48,581
Labor Productivity ('000 USD PPP)	3.985	0.014	-10.662	15.726	48,581
Number of workers (log)	35.943	0.795	1.000	1.16e+05	48,581
Firm Age	17.337	0.114	0.000	259.000	48,581
Firm mainly sells at local level	0.467	0.004	0.000	1.000	48,581
Firm mainly sells at national level	0.463	0.005	0.000	1.000	48,581
Firm mainly sells at intern. level	0.070	0.002	0.000	1.000	48,581
Financial statements audited	0.440	0.004	0.000	1.000	48,581
GDP per capita PPP (WB-2023)	24453	49.972	1,039	1.32e+05	47,632
B-Ready quality of Credit Infrastructure	46.321	0.074	5.833	85.278	21,618
B-Ready quality of Credit Information	28.238	0.048	0.833	44.167	21,618

Appendix B. Robustness tests

Table B.1: Robustness Test

	(1)	(2)	(3)	(4)	(5)
Firm receives EP? (%)=1	-0.033***	-0.033***	-0.038***	-0.034***	-0.057***
	(0.011)	(0.011)	(0.012)	(0.012)	(0.011)
Observations	48,581	48,581	47,652	45,704	48,581
Control Variables	Yes	Yes	Yes	Yes	No
Country Fixed Effects	Economy Level	Economy Level	Location Level	No	Economy Level
Industry Fixed Effects	Broad Level	Narrow Level	Narrow Level	No	Broad Level
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Industry*Economy Fixed Effects	No	No	No	Yes	No

Note: Standard errors in parentheses. This table reports robustness checks to different specifications of our main regression. Broad Level Industry Fixed Effects control for 8 different industry sectors; Narrow Level Industry Fixed Effects control for 49 different industry sectors. Location Level Fixed Effects control for each subnational division available in ES within an economy. Industry*Economy Fixed Effects control for economy-level fixed effects interacted with Broad Level industry fixed effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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