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The External Finance and Labor Productivity in Laos: Impacts and Mechanisms.

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ABSTRACT

Small and medium-sized enterprises (SMEs) are crucial for a country's growth and development, yet many face challenges in expanding due to limited access to finance. This study investigates the impact of access to external finance on firms' labor productivity using data from the World Bank Enterprise Survey of Laos (2009-2018). Employing a novel double-lasso regression approach, this study confirms the positive effect of access to finance on SMEs' labor productivity. However, this effect diminishes as firms grow larger in size. Notably, the double-lasso regression simultaneously determines key factors influencing access to finance, highlighting security payments as a previously overlooked determinant. Moreover, investment in worker training is found to be a key mechanism for boosting firms' labor productivity.

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1. Introduction

Small and medium-sized enterprises (SMEs) play a critical role in a country's overall economic growth and development. They represent up to 90% of all businesses, 70% of employment, and 40% of gross domestic product (GDP) (World Trade Organization, 2016). Moreover, they also contribute to innovation, competition, and poverty reduction. There are no clear definitions of SME with different countries and organizations having their own criteria. In some cases, small- and micro-sized firms are distinguished, and the term will expand to include micro, small, and medium enterprises (MSMEs).

Despite their pivotal role in the economy, many SMEs struggle to develop and expand their operation. Several factors hinder the growth and development of SMEs. The lack of access to external financing is one critical constraint (Bruhn et al., 2017). This is especially true in developing countries, where the financial market is underdeveloped and cannot provide the products and services needed by SMEs. According to the latest report, the demand for financing by MSMEs in developing countries is estimated to be around $8.9 trillion compared to the credit supply of $3.7 trillion, leaving a gap of $5.2 trillion (Bruhn et al., 2017). In addition, demand for credit by informal MSMEs is estimated to be around $2.9 trillion, further highlighting the importance of external financing.

Laos has 133,997 enterprises, with 99.1% categorized as micro and small firms (Ministry of Planning and Investment, 2019). Despite constituting 82% of private sector employment, SMEs contribute only 16% to GDP, which is significantly lower than that of neighboring countries (Figure 1). Growth prospects for SMEs are limited, with only 39% of micro firms progressing to small firms, and only 5% of small firms advancing to medium size from 2011 to 2013 (World Bank, 2017). Access to external financing remains a major growth impediment, as evidenced by the low loan uptake of 9.9%, down from 12.1% in the previous economic census (Ministry of Planning and Investment, 2015, 2020). Moreover, SMEs exhibit limited competitiveness, with only 3.2% of their income derived from exports. In comparison with similarly developed countries, Laos' manufacturing firms display low productivity and capital

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intensity, with no growth observed between 2005 and 2012 (World Bank, 2017).

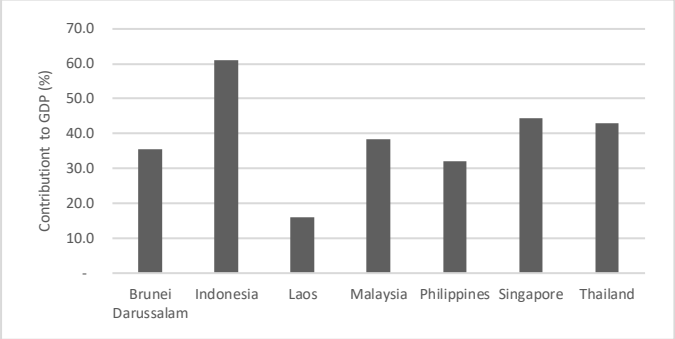

Figure 1. SME contribution to GDP (2017 and 2018)
Source: Author's compilation from Asian Development Bank 2020 and World Bank 2017

Despite the perceived significance of external financing for SMEs, empirical evidence regarding the relationship between access to finance and SME performance remains contentious (Adegboye & Iweriebor, 2018; Bokpin et al., 2018; Fafchamps et al., 2014; Fernandes, 2006; Gatti & Love, 2008; Kaboski & Townsend, 2012). Several factors contribute to these mixed findings in the empirical literature. Firstly, many studies have overlooked the underlying mechanisms. Secondly, the issues of reverse causality and self-selection plague much of the research.

Therefore, this study aims to examine the impact of access to external finance on firm labor productivity, focusing on SMEs. It also explores the mechanism through which this occurs using the firm-level World Bank Enterprise Survey (WBES) of Laos. Along the way, it also identifies important determinants of financial access. This study makes use of the double-lasso regression, which has never been used before, to tackle this specific problem. This method will help identify the impact of external financial access on firm labor productivity while simultaneously identifying the determinants of access to finance. This is different from previous studies, where these analyses are typically performed separately. In order to address the econometric issues related to reverse causality and self-selection problems, entropy balancing technique is used along with fixed effect regression. This step also serves as a robustness test for the double-lasso regression.

This study contributes to the literature in three ways. First, it enhances our understanding of the determinants of access to finance. Previous studies have often employed probit or logit models with limited control variables to test the determinants of financial access (Adegboye & Iweriebor, 2018; Beck et al., 2006; Beck & Cull, 2014; Fatoki & Asah, 2011; Hainz & Nabokin, 2013; Harvie et al., 2013). However, these approaches may overlook important, yet untested indicators. This study addresses this gap by employing a double-lasso regression to simultaneously conduct variable selection and coefficient estimation, potentially uncovering overlooked indicators.

Second, this study advances the literature on the impact of access to external financing on firms' labor productivity by addressing reverse causality and self-selection issues. This is achieved through entropy balancing as a data pre-processing step to create control and treatment groups (with and without access to financing) with similar characteristics before causal estimation, as seen in Phung (2021).

Finally, this study enriches the literature on the effect of external financing on firm performance. Previous studies have often focused solely on the primary impact of access to finance on firm performance, with limited exploration of the underlying mechanisms. Those that delve into mechanisms, such as Fafchamps et al. (2014), typically use experimental data that can be difficult to obtain. This study investigated these mechanisms using the entropy matching method with observational data.

The remainder of this paper is organized as follows. Section 2 discusses the background of financial sector development in Laos, and the definition of SME used in this study. Section 3 explores related literature on the impact of external finance on firm performance, potential mechanisms, and determinants of SMEs' access to finance. Section 4 details the data and methodology used in this study. Section 5 discusses the results of the analysis and Section 6 presents the conclusions and recommend-dations.

2. Background of Financial Sector Development

The initiative to enhance SME access to finance in Laos began with the establishment of the state-owned Lao Development Bank (LDB) in 2003. By 2008, the LDB had transitioned into a bank focused on offering credit to SMEs (Asian Development Bank, 2020; Polsaram et al., 2011). In 2011, the Ministry of Industries and Commerce introduced the SME promotion fund managed by the Department of SME Promotion to further facilitate SMEs' access to finance. This fund aimed to provide a line of credit to banks, including the LDB, enabling them to offer loans at interest rates 3–5% lower than commercial rates (Asian Development Bank, 2020).

Non-bank financial institutions present an alternative avenue for SMEs to access external financing. These institutions, such as microfinance institutions (MFIs), money transfer shops, leasing companies, and pawnshops, offer financing options for SMEs, particularly MFIs and leasing companies. As of 2019, there were 96 MFIs, 26 credit unions/cooperatives, 29 leasing companies, 26 pawnshops, and five money transfer shops registered with the Bank of the Lao PDR. Together, they hold a total outstanding financing amount of 6.1 billion kips, constituting 8.5% of the entire bank loan outstanding (Asian Development Bank, 2020).

The government also implemented policies to strengthen its financial infrastructure. The secured transaction law, enacted in 1994 and enforced in 2011, permits movable assets, such as inventory, accounts receivable, and intellectual property rights, as collateral for loans (Asian Development Bank, 2020). Plans, including the establishment of a national collateral registry, are underway to amend this law. Additionally, the Credit Information Bureau offers monthly updates for firms to review their information, albeit at a small fee for third parties. Many organizations provide SME training, such as Lao Securities Commission Office, offering capital market literacy for LSX utilization. The Lao National Chamber of Commerce and Industry offers training in loan applications, bookkeeping, financial records, and business plans. The Lao Microfinance Association conducts capacity building for MFIs in performance management, accounting, and client protection.

Despite these efforts, access to finance remains a significant hurdle for SMEs, which hinders their growth and development. The latest 2019 economic census (Ministry of Planning and Investment, 2020) revealed that only 9.9% of enterprises in Laos have loans, a decrease from 12.1% in the 2013 census. In 2013, the majority of these loans (69.11%) were from domestic banks, followed by loans from village banks, friends, and family (26.04%); financial institutions/microfinance (3.1%); and foreign banks (1.75%). However, by 2019, the share of loans from foreign banks had increased to 6.1%, surpassing financial institutions/microfinance at 5.9% (Figure 2).

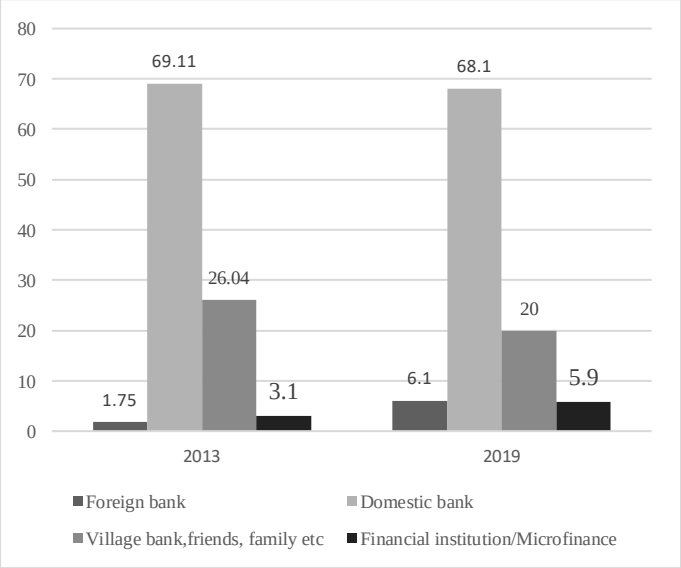

Figure 2. Sources of loans for enterprise in Laos
Source: Author's compilation using data from the Ministry of Planning and Investment 2015 and Ministry of Planning and Investment 2020.

One significant challenge contributing to this scenario is the stringent qualification criteria set by banks participating in SME promotion funds. SMEs struggle to meet the requirements, as applying for this credit demands up to 16 documents, each incurring fees, making the process complex and costly (Silipanyo, 2021). Moreover, the share of MSME loans to total loans decreased from 30.9% in 2015 to approximately 19.8% in 2019, accompanied by a decline in the share of MSME loans to GDP from 12.7% to 8.5% during the same period (Figure 3). These trends indicate the challenges for SMEs in accessing external financing.

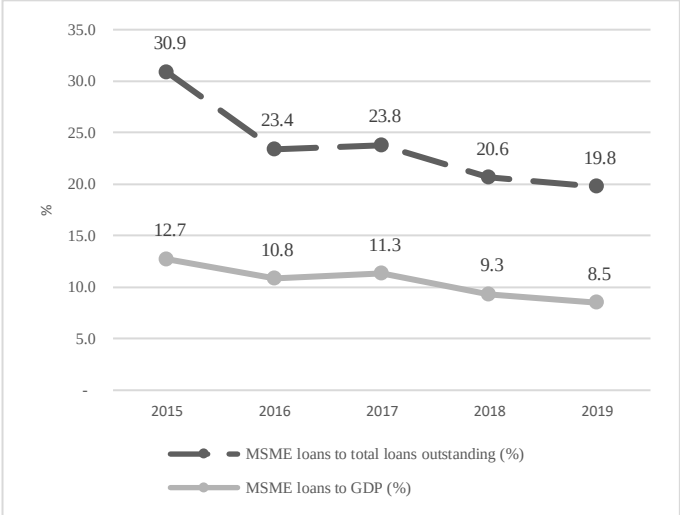

Figure 3. Sources of loans for enterprise in Laos
Source: Author's compilation, from Asian Development Bank 2020

3. Literature review

3.1 Impact of Access to Finance on Firm Performance

Financial development is widely acknowledged to have a positive relationship with economic growth; however, the link between access to finance and firm productivity remains inconclusive. Several studies have explored this association using various methodologies and datasets. Gatti & Love (2008) utilized ordinary least squares (OLS) regression with cross-sectional firm-level data from Bulgaria and find a positive correlation between access to credit and firm TFP. Bokpin et al. (2018) observed a similar impact in sub-Saharan Africa. Kaboski & Townsend (2012) conducted a quasi-experiment on microfinance programmes in Thailand and concluded that recipients experienced increased profits and income.

In contrast, Fernandes (2006) analyzed data from Bangladesh and found that firms with a line of credit exhibited higher TFP, while those with bank loans showed lower TFP. This implies varying impacts of short- and long-term loans on productivity. Giang et al. (2019) used a difference-in-difference approach to study Vietnam's manufacturing SMEs, revealing a direct positive effect of improved financial access on firm productivity, particularly with bank loans.

Examining the impact of limited financial access on firm performance, Motta (2020) studied Brazilian firms using OLS regression and propensity score matching, indicating that SMEs rejected for bank loans had lower labor productivity. Conversely, Adegboye & Iweriebor

(2018) analyzed Nigerian SMEs and found no significant increase in productivity solely from access to finance; productivity growth was linked to the amount of investment financed by bank loans. Fafchamps et al. (2014) conducted a randomized control trial in Ghana, suggesting that cash transfers have a lower impact on microenterprise profits than in-kind transfers in the short term.

Firm performance can be measured in various ways, with the common metrics being labor productivity and TFP. The choice between these depends on factors such as the study's timeframe and the quality of capital stock data. Sargent & Rodriguez (2001) suggest labor productivity for studies under a decade, as TFP requires precise capital stock measurements. Given the availability and reliability of labor productivity data, this study uses it as a measure of firm performance.

3.2 Mechanism of Access to Finance on Productivity

The existing body of research has highlighted the positive impact of access to external financing on firm productivity. However, the specific mechanisms underlying this relationship remain unclear. Nonetheless, extensive literature exists on the determinants of firm productivity that can provide us a foundation for exploring the essential mechanisms through which access to finance influences firm productivity.

The Neoclassical growth production function identifies capital, labor, and technological advancement as the main components of production. Improvements in any of these three factors should theoretically improve the productivity. Other studies also use these three components to break down labor productivity growth (Vu, 2014; Jorgenson & Sttiroh, 2000), as cited in Ohno et al., 2021). This study focuses on these three components of production to find a mechanism for labor productivity.

Numerous studies have examined the link between human capital and productivity. For instance, Baharin et al. (2019) estimated the short- and long-term impacts of education on labor productivity in Indonesia using an autoregressive distributed lag model. Their study showed that primary, secondary, and tertiary education positively and significantly impacted labor productivity in the short run. However, only primary and secondary education are positive and significant in the long run, whereas tertiary education has a negative and significant impact. In addition, the human capital theory of labor productivity identifies education level, formal training, managers' experience, and R&D as primary drivers of firm-level productivity (Amutabi & Wambugu, 2020). Fallahi et al. (2010) tried to test this theory using data from Iran's manufacturing firms. They tested the impact of workers' education and training expenditures on labor productivity and found that worker education had a significantly positive effect.

Capital investment has been proven to have a positive impact on firm productivity. For instance, Amutabi & Wambugu (2020) found that a 1% increase in capital intensity can increase the labor productivity of SMEs and large-sized firms in Kenya by 0.57%. In a closely related study, Fafchamps et al. (2014), as mentioned in Ghana's research, found that providing equipment to entrepreneurs could increase profits. Their results were consistent with those of both female and male entrepreneurs. This suggests that if finance is invested in capital, productivity or profitability could increase.

Innovation has also been proven to contribute positively to firm productivity (Crespi & Zuniga, 2012; De Fuentes et al., 2015; Hall et al., 2009). Studies have shown that advancements in technological know-how can lead to more effective use of resources and better conversion of new ideas into new products, processes, and services, which is fundamental for a firm's competitive edge (Crespi & Zuniga, 2012).

This thesis attempts to determine the mechanism through which access to finance can influence a firm's labor productivity. This is accomplished by implementing an interaction between each indicator of access to finance and the determinants of firm labor productivity, including capital investment, formal training, and innovation. It then estimates the impact of these interactions on labor productivity.

3.3 Determinant of Access to Finance

Firms that use financial products or services are considered to have access to finance; however, not all firms require external financing (Gatti & Love, 2008; Hainz & Nabokin, 2013). According to the pecking order theory, firms prioritize funding sources, starting with retained earnings or borrowing from acquaintances, followed by debt financing, and finally, equity financing (Chavis et al., 2011). Thus, if firms can meet their financing needs through internal resources or borrowing from acquaintances, the need for external financing diminishes. Other factors, such as limited growth opportunities, reluctance to expand, and lack of financial literacy among entrepreneurs, can also influence the absence of external funding (Gatti & Love, 2008).

Numerous global studies examine factors influencing firms' access to finance, often utilizing probit or logit models. These consistently identify firm size as significant, with smaller firms facing greater difficulty in accessing financing (Beck & Cull, 2014; Fatoki & Asah, 2011; Hainz & Nabokin, 2013; Kira & He, 2012). Smaller firms are 30% less likely to secure formal bank loans, with foreign- and government-owned firms facing similar challenges (Beck & Cull, 2014). However, older firms, particularly those in sub-Saharan Africa, tend to have better access. Meanwhile, in Southeast Asia, foreign-owned firms demonstrate self-reliance in financing (Harvie et al., 2013), although a study in Germany shows

that foreign-owned manufacturing firms face more financial restrictions (Wagner & Weche Gelübcke, 2015).

Moreover, additional studies have sought to broaden this analysis by examining a wider range of determinants. Beck et al. (2014) highlight factors such as location, business information, age, size, and collateral, whereas Kira & He (2012) include industry and incorporation as influences. Transparency, measured by adherence to accounting standards or external audits, significantly affects access to finance (Hainz & Nabokin, 2013).

A country-level analysis indicates that better creditor rights positively impact access to credit, with institutional development crucial in explaining financing variation across countries (Beck & Cull, 2014; Hainz & Nabokin, 2013). Firm performance, such as profit margin or sales growth, influences access to credit, although the findings vary (Hainz & Nabokin, 2013; Harvie et al., 2013; Pandula, 2011). Entrepreneur characteristics such as education level and networking also affect access to finance, with wealthier owners receiving larger loan offers (Fatoki & Asah, 2011; Harvie et al., 2013; Pandula, 2011).

The literature highlights numerous factors influencing firms' access to finance, often contingent on available data and research methodologies. Depending on the region and the analytical approach, certain determinants may present conflicting findings. To address this, our research uses double-lasso regression to identify the most pertinent factors affecting firms' access to finance from extensive WBES data.

4. Methodology

4.1 Data

The dataset used for this research was obtained from the WBES. It is a representative survey of an economy's private sector. The survey's primary focus was on formal firms in the manufacturing and service sectors. Full government or state-owned companies were not included in the survey. The sampling method used for conducting the survey was stratified random sampling. The dataset contains information regarding firm characteristics, performance indicators, owner information, and access to finance.

Moreover, it includes information on other business environments, such as bribery, licensing, infrastructure, crime, and securities. It also contains information on whether the firm applied for any credit in the previous fiscal year and, if not, why they did not apply. This is important when distinguishing firms that need external financing from those that do not. The dataset for this study contains firm-level cross-sectional data on the Laos economy for 2009, 2012, 2016, and 2018, with a total sample size of 1,439 firms.

In the original dataset, firms are already categorized into different sizes according to the definition stipulated in Prime Minister Decree No. 24. The impact on each firm size can be observed by disaggregating firms into various sizes. Additionally, age, location, sector, and incurporation were disaggregated for similar reasons. Information on access to finance includes whether firms have access to a line of credit or overdraft, use part or all bank loans to finance working capital, and use part or all bank loans to finance the purchase of fixed assets. However, data on the use of overdrafts are only available for three years, while data on firms' purchases of fixed assets account for less than 5% of the total sample size. Therefore, they were not included in this study's analysis. Following Love (2009), the variable *Credit* was constructed as one of the main access to finance indicators to determine whether the firm has a line of credit or bank financing for working capital. Other access to finance indicators includes a line of credit and working capital loans.

When discussing access to finance, it is common to approximate it by the usage of finance. However, the lack of usage of financial products or services does not always indicate that the firm has a problem accessing finance. Firms that do not use external financing can fall into either the category of being financially constrained or simply have no demand for external financing (Hainz & Nabokin, 2013). Therefore, it is crucial to distinguish between firms that demand external financing and those that do not. Following Hainz & Nabokin (2013), the variable *Need finance* was constructed for this purpose, and the firms that are considered to have demand for credit are made up of the following group:

1. Firms that are already using credit, such as a line of credit or finance part or all of the working capital with bank loans.
2. Firms that applied for loans but were rejected.
3. Firms that want to apply for loans but are discouraged by reasons such as too complex application procedure, unsuitable interest rate, too high collateral requirements, insufficient loan size, and maturity were not sufficient, think that their application would be rejected, and other reasons.

Moreover, the survey contained information on the elements of the business environment and which of these are considered the biggest obstacles faced by each firm. They are included in the analysis as proxies for institutions because they represent various aspects of the business environment. Table 1 shows the detailed definitions of each element and other variables relevant to this study.

Table 1. List of variables

Variables	Definition
Dependent variables	
Labor productivity	Log labor productivity (total sales/number of permanent workers)
Focal Independent variables	
Credit	Dummy of firms that have either line of credit or working capital finance. 1=yes 0=no
Line of credit	Dummy variable of firms with a line of credit. 1=yes 0=no
Working capital loan	Dummy variable of firms that has parts or all of its working capital financed by bank loan 1=year 0=no
Bank account	Dummy of firms that have bank account 1=yes 0=no
Other control variables	
Foreign ownership	Dummy of firms with a share of foreign ownership of more than 10%. 1=yes 0=no
State ownership	Dummy of firms with state ownership. 1=yes 0=no
Manager experience	Experience of a manager working in the sector
Gender	Gender of the owner. 1=male 0=female
Gross profit margin	gross profit margin (sales-cost of goods sold)/sales
Export	Dummy of firms that export. 1=yes 0=no
Certificate	Dummy of firms with internationally recognized certificates. 1=yes 0=no
Financial statement	Dummy of firms with financial statements checked and certified by external auditor 1=yes 0=no
Register	Dummy of firms that formally registered at the beginning of the operation. 1=yes 0=no
Website	Dummy of firms that have a website. 1=yes 0=no
Competition	Dummy of firms that compete against informal firms. 1=yes 0=no
Security	Dummy of firms that pay for security (equipment, personnel, professional security service). 1=yes 0=no
Theft	Dummy of firms that experience losses due to theft, robbery, etc. 1=yes 0=no
Fixed asset investment	Dummy of firms that purchased new or used fixed assets in last FY. 1=yes 0=no
Government contract	Dummy of firms that have secured or have attempted to secure gov contracts. 1=yes 0=no
Operating license	Dummy of firms that submit an application to obtain an operating license in the last two years. 1=yes 0=no
Import license	Dummy of firms that submit an application to obtain an import license in the last two years. 1=yes 0=no
Location	Dummy of firms located in the capital. 1=capital 0=non-capital
Firm age	
Young firm	Dummy of young firm with age between 0-5 years. 1=yes 0=no
Medium age firm	Dummy of medium age firm with age between 6-10 years. 1=yes 0=no
Mature firm	Dummy of mature firm with an age of 11 years and older. 1=yes 0=no
Firm size	
Small firm	Dummy of small size firm with employee less than 20. 1=yes 0=no
Medium firm	Dummy of medium size firm with employees between 21-99. 1=yes 0=no
Large firm	Dummy of large size firm with employees more than 100. 1=yes 0=no
Sector	
Manufacturing	Dummy of firms in the manufacturing sector. 1=yes 0=no
Retail	Dummy of firms in the retail sector. 1=yes 0=no
Service	Dummy of firms in other sectors. 1=yes 0=no
Incorporation	
Sole proprietorship/Partnership	Dummy of sole proprietorship/partnership firm. 1=yes 0=no
Limited company	Dummy of the limited company firm. 1=yes 0=no
Other	Dummy of other forms of firm. 1=yes 0=no
Biggest obstacles	
Access to finance	Access to finance as biggest obstacle faced by the firm
Access to land	Access to land as biggest obstacle faced by the firm
Business licensing and permits	Business licensing and permits as the biggest obstacle faced by the firm
Corruption	Corruption as the biggest obstacle faced by the firm
Courts	Courts as biggest obstacle faced by the firm
Crime, theft, and disorder	Crime, theft, and disorder as the biggest obstacle faced by the firm
Customs and trade regulations	Customs and trade regulations as biggest obstacle faced by the firm
Electricity	Electricity as biggest obstacle faced by the firm
Inadequately educated workforce	Inadequately educated workforce as biggest obstacle faced by the firm
Labor regulations	Labor regulations as biggest obstacle faced by the firm
Political instability	Political instability biggest obstacle faced by the firm
Practices of competitors in the informal sector	The practice of competitors in the informal sector as biggest obstacle faced by the firm
Tax administration	Tax administration as biggest obstacle faced by the firm
Tax rates	Tax rates as biggest obstacle faced by the firm
Transport	Transport as biggest obstacle faced by the firm
Other variables	
Need finance	Dummy of firms that needs or wants financial service or product. combination of firms that already have access to credit, firms that apply for loans, and firms that are constrained 1=need 0=don't need

Source: Author's compilation

4.2 Double-Lasso Regression

We begin our analysis using double-lasso regression to determine the impact of external finance on firm labor productivity. In addition, the double-lasso also performs variable selection, allowing us to identify the determinants of access to finance.

The Lasso regression, in a way, is similar to normal linear regression. The beta coefficient in the linear regression was determined by minimizing the residual sum of squares. This technique exhibits the smallest variance among all linear unbiased beta estimates under certain assumptions. However, a problem arises when there are many predictors or multicollinearity among the predictors, which violates this assumption. Consequently, the least squares estimate becomes unstable and produces a model with poor predictive power. Another problem with the least squares estimate is that it assigns a non-zero value to all the coefficients. As a result, the least square estimate will give a complex model and have poor predictive power when many predictors are included (Gunes, 2015).

Lasso regression can circumvent these problems. In addition to using the least-squares estimate to calculate the coefficient, Lasso incorporates a penalty term. The penalty term will cause the regression coefficient to shrink towards zero. If shrinkage is sufficiently large, the regression coefficient is equal to zero. The ability to shrink the regression coefficient to zero allows Lasso to simultaneously perform variable selection and coefficient estimation (Gunes, 2015). Furthermore, the shrinkage properties allow the Lasso regression to have many predictors relative to the small number of observations (Urminsky et al., 2016).

However, the Lasso regression on its own also has weaknesses. It tends to underestimate non-zero coefficients; therefore, it may mistakenly exclude them, especially if these variables have a moderate effect. Excluding covariates with moderate but non-zero effects could lead to omitted variable bias. In order to overcome this problem, the "Double Lasso" variable selection procedure was introduced (Urminsky et al., 2016).

The goal of the double-lasso is to select relevant covariates in two steps, finding those that predict the dependent variables and those that predict the independent variables, and can be performed as follows:

Step 1: perform a lasso regression predicting the dependent variable while keeping track of covariates with non-zero coefficients

$$Y_i = \alpha_0 + \alpha_K W_{ik} + \varepsilon_i \quad (1)$$

Step 2: perform similar lasso regression but this time predicting the focal independent (treatment) variable and keeping track of non-zero coefficients

$$X_i = \delta_0 + \delta_K W_{ik} + \varepsilon_i \quad (2)$$

If X_i is an effectively randomized treatment, no covariates should be selected. This step can help to avoid omitted variable bias, and in experimental data, it can also serve as a test of randomization.

Step 3: perform linear regression to see the effect of focal independent (treatment) variable on the dependent variable while including the covariates selected from steps 1 and 2

$$Y_i = \beta_0 + \beta_1 X_i + \Sigma_{k\epsilon A}\, \beta_{k+1}\, W_{ik} + \varepsilon_i \quad (3)$$

In this study, the dependent variable Y_i is the log of labor productivity following the work of Huselid (2021), which is calculated by the following equation:

$$Labor\ Productivity = \log\left(\frac{total\ sales}{No.of\ permanent\ worker}\right) \quad (4)$$

The focal independent variables X_i are various indicators of access to finance. These include lines of credit, working capital loans, and credit. Moreover, bank account was also tested to see the impact of having access to a banking system on firm labor productivity.

W_{ik} represents multiple potential covariates or independent variables. These independent variables are presented in Table 3. α_K, δ_K, and β_{k+1} represent the beta coefficient in each step in the double-lasso regression, while A denotes the combined non-zero coefficients in Steps 1 and 2. It is important to emphasize that only firms identified as needing financial products and services are taken into consideration in the analysis. The double Lasso analysis for this study was performed using the *pdslasso* command of Stata software (version 16).

4.3 Fixed Effect Regression

Fixed effect regression was conducted to assess the treatment effect of access to finance on firm productivity. Prior to the regression analysis, the entropy balancing method was employed to balance the covariates of the treatment (firms with external finance) and control (firms without external finance) groups. The purpose of this preprocessing step is to eliminate the influence of background covariates on the treatment variable, reducing the model's dependency on later treatment effect estimations (Ho et al., 2007).

Although preprocessing methods are gaining popularity, there is no consensus on the optimal approach. In social science research, matching and propensity score matching methods are often used. However, these methods are laborious and require researchers to iteratively and manually perform propensity score modeling, matching, and balance checking until an acceptable balance is achieved. Additionally, correct model specifications and large samples are necessary, and these complex processes often result in suboptimal balance. In some cases, improving the balance of certain covariates through matching can introduce bias by reducing the balance of other covariates (Hainmueller, 2012; Ho et al., 2007).

To address these challenges, Hainmueller (2012) introduced the entropy balancing method to balance covariates in observational studies with a binary treatment. This method involves selecting covariates as balancing constraints to match the treatment and control groups based on specified moments. The process adjusts the weight of each sample unit to satisfy the set of imposed balance conditions while retaining as much information as possible for the subsequent analysis. The resulting weight was used to adjust the control group to match the moments of the treatment group.

The entropy balancing method has several advantages. It allows researchers to achieve a high level of covariate balance using a broad set of balancing conditions. Furthermore, it retains a substantial amount of valuable information in the preprocessed data, and the weights generated can be used in other standard estimations of the treatment effects (Hainmueller, 2012).

In this study, the covariates identified as significant by the double-lasso regression were used as balancing constraints for entropy balancing, whereas the treatment variables consisted of various indicators of access to finance. Entropy balancing was conducted using STATA e-balance package version 16.0.

By testing the impact of post-entropy balancing, we can estimate the causal effect of access to external financing on firms' labor productivity. This is feasible because, after entropy balancing, the only difference between the control and treatment groups is access to finance. Therefore, any effect observed in the regression results can be attributed to access to finance. This step also served as a robustness check for the main estimation. The weighted regression was conducted as follows:

$$Y_{ist} = \beta_0 + \beta_1 acc_{ist} + \beta_2 X_{ist} + \gamma_t + \tau_s + \varepsilon_{ist} \quad (5)$$

Where Y_{ist} represent labor productivity of firm i in sector s at year t. acc_{ist} are the access to finance indicators which include credit, line of credit, working capital loan, and bank account. X_{ist} are the set of additional control variables which include manager experience, gender, foreign ownership, firm age, gross profit margin, financial statement, registered, certificate, fixed asset investment, and export. γ_t denotes the year fixed effect, τ_s denotes sector fixed effect and ε_{ist} is the error term.

4.4 Test for Mechanisms

To determine the mechanism by which access to finance can impact a firm's labor productivity, the interaction between each indicator of access to finance and each potential channel identified in the literature was regressed on labor productivity using a fixed-effect regression. However, similar to the previous analysis, entropy balancing was performed to balance the covariates of the treatment and control groups before fixed-effect regression was performed. The regression analysis was performed as follows.

$$Y_{ist} = \beta_0 + \beta_1 acc_{ist} * mechanism_{ist} + \beta_2 X_{ist} + \gamma_t + \tau_s + \varepsilon_{ist} \quad (6)$$

Where mechanism are the potential channels in which access to finance can impact labor productivity. These include the following:

fixed asset investment: dummy of whether the firm purchased new or used fixed assets in the last fiscal year with 1=yes and 0=no.

formal training: dummy of whether the firm provided formal training in the previous fiscal year with 1=yes and 0=no.

product innovation: dummy of whether the firm introduced any new or improved product or services in the last three years with 1=yes and 0=no.

process innovation: whether the firm introduced any new or improved process in the last three years with 1=yes and 0=no.

5. Results

5.1 Descriptive Statistics

Table 2 provides the descriptive statistics for our dataset. Approximately 80% of the surveyed firms fall under the SME category, which is a common global trend. Among these, small firms constitute 51%, medium-sized firms 31.9%, and the remainder are large firms. The majority of firms are established entities, with 56.9% operating for over 11 years. Approximately 44.4% of the firms are located in the capital city. Manufacturing and retail sectors each represent around 28% of all firms, with the remaining in various sectors. Within the SME category, 23.6% were manufacturing, 31.9% were retail, and 41.3% were services. Only 11.6% of all firms have foreign ownership, dropping slightly to 8.1% for SMEs. Export activity is limited, with only 10.1% of all firms and 6.1% of SMEs participating. Few firms have their financial statements audited externally (23.7% for all firms, 21.8% for SMEs) or hold internationally certified certificates (8.3% for all firms, 5.8% for SMEs).

In terms of access to finance indicators, around 26% of surveyed firms have credit, slightly lower at 24.4% for SMEs. Additionally, 22.3% of firms have a line of credit, with 20.2% financing part or all of their working capital through bank loans, slightly reduced for SMEs at 20.6% and 19% respectively. The majority of firms, 79.4% for all firms and 78.8% for SMEs, have bank accounts. Furthermore, roughly 50.4% of firms express demand for financial products or services. Key obstacles faced by firms include tax rates, availability of educated workers, competition from the informal sector, access to finance, and electricity concerns.

Table 2. Descriptive statistics

	All Firms				SMEs			
Variable	Mean	SD	Min	Max	Mean	SD	Min	Max
Credit	0.26	0.44	0	1	0.24	0.43	0	1
Line of credit	0.22	0.42	0	1	0.21	0.40	0	1
Working capital loan	0.20	0.40	0	1	0.19	0.39	0	1
Bank account	0.79	0.40	0	1	0.79	0.41	0	1
Need Finance	0.50	0.50	0	1	0.49	0.50	0	1
Labor productivity	18.00	1.35	13.96	26.46	17.98	1.33	14.91	26.46
Location	0.44	0.50	0	1	0.40	0.49	0	1
Foreign ownership	0.12	0.32	0	1	0.08	0.27	0	1
Manager experience	14.62	9.99	0	60	14.30	9.88	0	60
Gender	0.61	0.49	0	1	0.57	0.50	0	1
State ownership	0.01	0.11	0	1	0.01	0.09	0	1
Export	0.10	0.30	0	1	0.06	0.24	0	1
Certificate	0.08	0.28	0	1	0.06	0.23	0	1
Financial statement	0.24	0.43	0	1	0.22	0.41	0	1
Fixed asset investment	0.33	0.47	0	1	0.32	0.47	0	1
Gross profit margin	0.50	0.34	-0.61	1	0.51	0.34	-0.58	1
Register	0.89	0.32	0	1	0.88	0.32	0	1
Website	0.28	0.45	0	1	0.23	0.42	0	1
Competition	0.40	0.49	0	1	0.43	0.49	0	1
Security	0.47	0.50	0	1	0.43	0.49	0	1
Theft	0.17	0.38	0	1	0.17	0.37	0	1
Government contract	0.11	0.31	0	1	0.10	0.30	0	1
Operating license	0.56	0.50	0	1	0.56	0.50	0	1
Import license	0.16	0.37	0	1	0.13	0.33	0	1
Firm age								
Young firm	0.16	0.37	0	1	0.17	0.37	0	1
Medium age firm	0.27	0.44	0	1	0.28	0.45	0	1
Mature firm	0.57	0.50	0	1	0.55	0.50	0	1
Firm size								
Small firm	0.51	0.50	0	1	0.62	0.49	0	1
Medium firm	0.32	0.47	0	1	0.38	0.49	0	1
Large firm	0.12	0.33	0	1	0	0	0	0
Sector								
Manufacturing	0.28	0.45	0	1	0.24	0.42	0	1
Retail	0.28	0.45	0	1	0.32	0.47	0	1
Service	0.41	0.49	0	1	0.41	0.49	0	1
Incroporation								
Sole proprietorship/Partnership	0.95	0.21	0	1	0.96	0.20	0	1
Limited company	0.03	0.18	0	1	0.03	0.16	0	1
Other	0.01	0.08	0	1	0.01	0.09	0	1
Biggest obstacles								
Access to finance	0.15	0.36	0	1	0.15	0.35	0	1
Access to land	0.03	0.18	0	1	0.04	0.20	0	1
Business licensing and permits	0.02	0.15	0	1	0.02	0.14	0	1
Corruption	0.02	0.14	0	1	0.02	0.15	0	1
Courts	0.01	0.07	0	1	0.01	0.08	0	1
Crime, theft and disorder	0.01	0.09	0	1	0.01	0.10	0	1
Customs and trade regulations	0.04	0.19	0	1	0.04	0.20	0	1
Electricity	0.09	0.28	0	1	0.09	0.29	0	1
Inadequately educated workforce	0.16	0.37	0	1	0.15	0.36	0	1
Labor regulations	0.01	0.09	0	1	0.00	0.07	0	1
Political instability	0.01	0.09	0	1	0.01	0.09	0	1
Practices of competitors in the informal sector	0.16	0.37	0	1	0.17	0.37	0	1
Tax administration	0.02	0.13	0	1	0.02	0.14	0	1
Tax rates	0.19	0.39	0	1	0.21	0.41	0	1
Transport	0.06	0.23	0	1	0.06	0.24	0	1

Source: Author's compilation

5.2 Result of Double-Lasso Regression

The results of the double-lasso regression are summarized in Table 3. It is evident that having access to finance significantly boosts firm labor productivity, a finding that is consistent across all firms and SMEs. This positive relationship is statistically significant at the 1% level, which aligns with the results of prior studies by Bokpin et al. (2018); Fernandes (2006); Gatti & Love (2008); Kaboski & Townsend (2012). Particularly for SMEs, access to finance appears even more crucial, as indicated by the higher magnitudes compared to all firms across most indicators, except for access to a bank account. Notably, having a line of credit shows the highest impact on labor productivity, with a 32.7% increase for all firms and 42.4% for SMEs. Surprisingly, having a bank account has a stronger effect on labor productivity than access to credit for all firms, although this effect diminishes for SMEs. This can be attributed to the broader market reach facilitated by online transactions.

The double-lasso regression identified gross profit margin as a significant determinant of access to finance, with a positive impact at the 1% level. This result supports the notion that financial institutions view profitable firms as less risky, thus increasing their likelihood of obtaining loans. However, this contrasts with Harvie et al. (2013), who found that firms with higher profit margins are less likely to access finance, aligning with the pecking order theory.

Additionally, security payments have emerged as a previously unexplored yet positively significant factor for all firms and SMEs. Firms investing in security measures may signal reliability and lower risks to lenders. Import licenses also have a consistently positive impact on all firms, likely because of the competitive advantages they provide in accessing innovative technologies and maintaining market share.

Conversely, electricity shortages negatively affect access to finance, indicating that firms facing power constraints may struggle to generate output and meet production demands, thus impacting their creditworthy-ness. This echoes findings by Nakhoda (2014) regarding Latin American firms. Overall, these results underline the vital role of access to finance, particularly for SMEs, in enhancing firm productivity. However, further robustness tests were conducted to validate these findings and mitigate potential biases.

Table 3. Impact on labor productivity using double Lasso regression.

	All firms				SMEs			
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Credit	0.262***				0.355***			
	(0.096)				(0.105)			
Line of Credit		0.327***				0.424***		
		(0.096)				(0.104)		
Working capital loan			0.309***				0.380***	
			(0.096)				(0.103)	
Bank Account				0.269**				0.188
				(0.131)				(0.142)
Foreign owenership	0.185	0.194	0.186		0.285			
	(0.148)	(0.147)	(0.147)		(0.187)			
Fixed asset purchased	0.139	0.132	0.136		0.117	0.133	0.134	
	(0.096)	(0.096)	(0.095)		(0.106)	(0.105)	(0.104)	
Gross Profit Margin	1.817***	1.823***	1.822***	1.839***	1.767***	1.753***	1.762***	1.797***
	(0.126)	(0.126)	(0.126)	(0.124)	(0.138)	(0.137)	(0.136)	(0.136)
Security payment	0.361***	0.346***	0.369***	0.351***	0.368***	0.403***	0.441***	0.379***
	(0.093)	(0.094)	(0.093)	(0.095)	(0.101)	(0.099)	(0.099)	(0.102)
Gov contract	0.028	0.028	0.016		-0.009			
	(0.144)	(0.143)	(0.143)		(0.159)			
Operating license	0.033	0.020	0.041		-0.051	-0.053		
	(0.094)	(0.094)	(0.094)		(0.102)	(0.100)		
Import license	0.304**	0.311**	0.296**	0.383***	0.300**			
	(0.123)	(0.122)	(0.122)	(0.117)	(0.146)			
Electricity	-0.576***	-0.545***	-0.582***	-0.597***				-0.538***
	(0.167)	(0.167)	(0.166)	(0.168)				(0.175)
Registered				0.210				0.330**
				(0.151)				(0.164)
Constant	16.762***	16.764***	16.771***	16.556***	16.719***	16.767***	16.751***	16.546***
	(0.113)	(0.111)	(0.110)	(0.174)	(0.117)	(0.114)	(0.102)	(0.188)
Observations	661	660	660	661	537	536	536	537

Source: Author's compilation

Note: This table shows the results of several regressions using different access to finance indicators. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

5.3 Result of Fixed Effect Regression

The fixed-effects regression results after adjusting for covariate differences using entropy balancing are presented in Table 4. Columns (1) to (4) present the results for all firms, whereas columns (5) to (8) display the results for SMEs. Access to finance continues to positively impact labor productivity for all firms and SMEs, consistent with the double-lasso regression. Notably, having a line of credit remains the most impactful, with labor productivity increasing by 37.4% for all firms and 48.7% for SMEs. Interestingly, the effects of all access to finance indicators are larger for SMEs than for all firms, except for bank accounts, which become smaller and insignificant for SMEs. This could suggest that external financing is particularly vital for SMEs to boost productivity, but its impact diminishes as firms grow. Moreover, bank accounts show a positive and significant impact on labor productivity when all firms are considered, indicating that larger firms benefit more from having a bank account than access to credit.

Table 4. Impact of access to finance on labor productivity using FE

	All firms				SMEs			
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Credit	0.275***				0.383***			
	(0.101)				(0.111)			
Line of Credit		0.374***				0.487***		
		(0.097)				(0.106)		
Working capital			0.254**				0.319***	
			(0.101)				(0.111)	
Bank Account				0.230**				0.008
				(0.096)				(0.104)
Constant	16.122***	16.144***	16.145***	16.125***	15.965***	15.963***	15.953***	15.968***
	(0.204)	(0.203)	(0.205)	(0.166)	(0.221)	(0.217)	(0.221)	(0.208)
Observations	621	620	620	621	503	502	502	503
R-squared	0.341	0.346	0.345	0.475	0.364	0.368	0.364	0.563
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Source: Author's compilation

Note: The regression includes controls for manager experience, gender, foreign ownership, firm age, gross profit margin, financial statements, registration, certificate, fixed asset investment, and exports. The results of the control variables were removed for presentation. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

5.4 Results for Mechanisms of Access to Finance

This section delves into how access to finance impacts firm labor productivity, with the results shown in Table 5. Columns (1) to (3) present the results for all firms, whereas columns (4) to (6) focus on SMEs.

In Panel A, we examine the impact of access to finance combined with investment in fixed assets on labor productivity. The findings suggest that having access to working capital loans and investing in fixed assets increase labor productivity by 13.7% and 25.9% for all firms and SMEs, respectively, although these results are not statistically significant.

In Panel B, the role of formal training is explored. The table indicates that interacting access to external finance with formal training can boost firm labor productivity. For instance, having credit and formal training increases productivity by 50.1% for all firms, while a line of credit and formal training results in increases of 53% and 49.3% for all firms and SMEs, respectively. Similarly, firms with working capital loans and formal training experience productivity gains of 65.9% for all firms and 53.4% for SMEs.

Panel C shows the impact of product innovation. The results show that combining product innovation with any access to finance indicators generally increases labor productivity, except for credit and product innovation for SMEs. However, these results were not statistically significant although they demonstrated a positive trend.

Finally, Panel D explores the impact of process innovation. The findings reveal that process innovation alongside a working capital loan increases firm labor productivity by 28.5% for all firms and 32.4% for SMEs, although these effects are not statistically significant.

These results underscore the significance of formal training in boosting labor productivity, regardless of the type of external financing. Moreover, access to working capital appears to have the most substantial impact on labor productivity, likely due to its customization, ease of access, and larger loan amounts compared to other forms of credit, especially unsecured lines of credit (Haynes, 2019).

Table 5. Impact of access to credit and different mechanisms on firm labor productivity

	All Firm			SMEs		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Fixed Asset Investment						
Credit * Fixed Asset Investment	-0.101			0.030		
	(0.194)			(0.213)		
Line of Credit * Fixed Asset Investment		-0.118			-0.034	
		(0.190)			(0.209)	
Working Capital loan * Fixed Asset Investment			0.137			0.259
			(0.194)			(0.212)
Observations	621	620	620	503	502	502
R-squared	0.342	0.346	0.346	0.364	0.368	0.366
Panel B. Formal Training						
Credit * Formal Training	0.501**			0.182		
	(0.221)			(0.266)		
Line of Credit * Formal Training		0.530**			0.493*	
		(0.216)			(0.255)	
Working Capital loan * Formal Training			0.659***			0.534**
			(0.216)			(0.252)
Observations	571	570	570	456	455	455
R-squared	0.353	0.356	0.363	0.381	0.386	0.387
Panel C. Product Innovation						
Credit * Product Innovation	0.090			-0.100		
	(0.223)			(0.234)		
Line of Credit * Product Innovation		0.104			0.028	
		(0.216)			(0.232)	
Working Capital loan * Product Innovation			0.128			0.149
			(0.224)			(0.238)
Observations	467	467	466	386	386	385
R-squared	0.393	0.407	0.397	0.400	0.408	0.404
Panel D. Process Innovation						
Credit * Process Innovation	0.135			-0.063		
	(0.245)			(0.265)		
Line of Credit * Process Innovation		0.021			-0.047	
		(0.228)			(0.250)	
Working Capital loan * Process Innovation			0.285			0.324
			(0.233)			(0.257)
Observations	468	468	467	387	387	386
R-squared	0.399	0.412	0.405	0.406	0.413	0.413
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Source: Author's compilation

Note: The regression includes controls for manager experience, gender, foreign ownership, firm age, gross profit margin, financial statements, registration, certificate, fixed asset investment, and exports. The interaction terms between the main access to finance indicators and the various mechanisms are shown. Other interaction and constant terms were removed for presentation purposes. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

6. Conclusions and Recommendations

This study investigates the impact of access to finance on firms' labor productivity and its mechanisms using data from Laos firms from 2009 to 2018. Employing a novel approach of double-lasso regression, this study confirms the positive impact of access to finance on a firm's labor productivity, particularly for SMEs. However, this effectiveness diminishes as firms grow larger in size. These findings align with prior research using different methodologies (Gatti & Love, 2008; Giang et al., 2019; Kaboski & Townsend, 2012), providing robust support for this relationship. To ensure the robustness of the results, fixed-effect regression was conducted after adjusting for differences between firms with and without access to finance.

Moreover, this study identifies profitability as a critical determinant of firms' access to finance. Additionally, it sheds light on previously overlooked determinants. For instance, security payments emerge as a significant factor influencing a firm's access to external financing, possibly signaling lower risk to financial institutions. Furthermore, possessing an import license appears to increase the likelihood of accessing external financing, suggesting alternative measures financial institutions may use when assessing loan risk.

Based on these findings, recommendations for firms include focusing on presenting positive financial performance and obtaining important licenses, such as security, to enhance their chances of securing external financing. Additionally, investing in worker training is highlighted as a key mechanism to boost firm labor productivity, especially through general training that can

be applied broadly within the organization. Government intervention through policies like subsidies for employer-provided training or tax deductions for firms investing in employee development could further bolster productivity. Finally, despite the availability of specialized loans for SMEs in Laos, numerous firms still face challenges in obtaining these loans due to the extensive documentation needed and high transaction fees. Strengthening financial institutions and regulations could safeguard creditors' rights and potentially alleviate these stringent requirements.

However, a limitation of this study is its focus on formal firms and formal bank financing, excluding the substantial informal sector prevalent in Laos and other developing countries. Future studies could broaden their scope to include informal sectors and non-bank financial institutions to provide a more comprehensive understanding of the financing landscape. Additionally, collecting direct measurements of collateral and more detailed firm performance indicators could enhance the analysis in future research.

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