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RESEARCH ARTICLE

Access to Credit Loans and Firm-level Productivity of Philippine Manufacturing Firms: An Endogenous Switching Approach

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Numerous studies have shown that financial development, such as access to credit loans, has a positive effect on firm-level productivity. However, the relationship between financial development and productivity remains an area of interest because positive effects should at least be accompanied by evidence of the absence or presence of both heterogeneity and selection bias effects. We examine this relation using extensive cross-sectional data from the World Bank Enterprise Survey of firms with access to credit loans and firms without access to credit loans. We employ instrumental variables regression and endogenous switching regression approach to test for selection bias from firms' participation and non-participation in credit loans and its impact on firm-level productivity and predict counterfactual productivity changes relative to access to credit loans and non-access to credit loans. We find evidence of productivity differences between the two groups of firms. Results under counterfactual predictions show productivity premium for firms with access to credit loans but not for firms that did not access credit loans. In sum, our results suggest a careful broadening of access to financial products and services.

Keywords: access to credit loans, firm-level productivity, manufacturing

JEL Classification: C34, D24, G2

Financial development through debt financing significantly impacts productivity growth (Levine & Warusawitharana, 2021). Many studies have, therefore, used varied econometric approaches to measure this link between financial development, in terms of access to credit loans, and productivity at the sectoral, industry, and firm levels. Most of the studies show evidence of a causal association between financial development and productivity (Arizala et al., 2013; Beck et al., 2000; Benhabib & Spiegel, 2000). Emerging economies such as China and Vietnam attest to the considerable impact of increased access to financing on productivity (Giang et al., 2019; Guillaumont-Jeanneney et al., 2006; Han & Shen, 2015). However, findings from various studies suggest that heterogeneities and discrepancies in productivity levels remain persistent across most industries, which may be attributed to different factors, including access to external finance, wherein greater credit loan accessibility is deeper for high-performing firms compared to low-performing firms (Arnold & Flach, 2017; Naceur et al., 2017). In the Philippines, differences in productivity growth levels across the manufacturing industry may be one reason firms seek external capital from the credit market to help bridge the productivity gap.

In 2018, the Philippines experienced solid macroeconomic fundamentals, with structural reforms contributing 1.5% year-on-year productivity growth (World Bank, 2018). According to Glindro and Amodia (2015), this productivity growth is the result of policy changes and economic reforms implemented, such as fiscal policies directed at the development of businesses, high-value-added products' diversification strategies, value chain development for agricultural commodities, educational and workforce development, innovation and technological advancements, and livelihood formation. Although these initiatives are vital, resource allocation is necessary for sustained productivity growth. However, research has shown that more comprehensive resource allocation on industries with high growth potential, such as the manufacturing sector, requires long-term external financing (Fisman & Love, 2004).

Various researchers have contributed to the literature examining financial development and its influence on firms' productivity. Ezzahid and Elouaourti (2018) found that limited access to the services offered by banks and other financial institutions is the reason why access to credit and productivity growth is statistically insignificant in both low and upper-middle-income economies. In an attempt to extend the study to consider depth, Shang et al. (2017) found that the financial depth or size of the loan market has no influence on firm-level productivity. Thise findings highlights that fluctuating or constrained credit allocation rather than the size of credit access affects productivity.

We use a robust methodological approach to examine the impact of financial development regarding firms' access to credit loans on firm productivity. The empirical link between financial development and productivity is complicated by endogeneity issues; precisely: (a) the decision to avail of credit access and productivity may be jointly linked, and (b) productive firms may self-select into credit access opportunities. Our paper addresses these issues by including in the estimation procedure the unobserved characteristics of firms that may simultaneously affect the decision to avail of credit access (rather than not avail of credit access) and increase productivity. We also tackle the self-selection issue, such as when productive firms self-select into credit access opportunities. In the presence of self-selection, the real effect of credit access on productivity will tend to be biased upward, making econometric estimates unreliable. We combine the simultaneous examination of the impact of financial development on productivity and exploit firm heterogeneity to identify salient firm-level characteristics. To this end, we introduce what-if-analysis through counterfactual conditionals that provide valuable insights on causal inferences, which, in turn, may help tailor the policy to Philippines conditions. In our model, we examine the contribution of access to credit loans on

firm productivity. We also examine productivity differences in counterfactual scenarios for firms that accessed credit loans and firms that did not.

Given the gaps in the literature, we pose the research question: does financial development matter in the productivity of Philippine manufacturing firms? Specifically, to address these pressing issues, we set the following goals: (a) explore the direct influence of financial development proxied by access to credit loans on firms' productivity and (b) examine whether there is a significant difference in the levels of productivity when firms acquire credit line facilities offered by financial institutions.

Literature Review and Hypotheses Development

Theoretical Foundations

The neoclassical growth theory integrates elements of the Schumpeterian theory that posits that short-run productivity is influenced by the advancement and development of technological knowledge driven by internal forces within the economic system. Measures of technological development at the firm and sectoral levels often employ total factor productivity, which considers the contributions of labor, capital, and technology to output. Additionally, this theory encompasses long-run productivity growth, which is affected by the rate of technical progress and production functions that can be independent of other economic activities (Solow, 1956; Swan, 1956; Howitt, 1999). In this study, we utilized a modified Cobb-Douglas function as the productivity model equation to address the limitations of the traditional approach. The traditional Cobb-Douglas function, commonly used in productivity assessments for manufacturing organizations, assumes fixed coefficients and time-invariant effects, leading to potential issues like heteroskedasticity and serial autocorrelation. However, Hosain and Al-Amri (2010) found that the Cobb-Douglas function still performs well in cross-sectional research, particularly when examining fixed coefficient effects and endogenous growth in specific sectors or industries. Thus, this study adopted the modified Cobb-Douglas production equation proposed by Seker and Saliola (2018) to address the identified difficulties.

On the other hand, the finance-led growth hypothesis suggests that the financial market plays a substantial role in driving real economic growth and development. The growth is realized through financial intermediation that enables the transfer of scarce resources from surplus spending units to deficit units, promoting investment and fostering economic growth (Ovat, 2012). In comparison, Offum and Ihuoma (2018) emphasized the strategic roles of capital markets and stringent regulatory policies in the sustainability of monetary funds for sustainable industrial development. Moreover, numerous studies have integrated the finance-led growth hypothesis and neoclassical growth theories in examining firm-level productivity. Empirical evidence indicates that the influence of financial development on firm productivity is likely associated with resource allocation, particularly in large industries with significant growth prospects (Beck et al., 2000; Fisman & Love, 2004).

Moreover, other empirical studies have demonstrated significant positive effects of financial development on TFP growth through improved access to the banking system, which enhances networking and resource allocation (Chen, 2010; López, 2017). Networking facilitates firms' participation in financial markets and stimulates growth. Levine and Warusawitharana (2014) found that increased access to finance in the form of loans and credits in debt markets can potentially enhance future productivity. Furthermore, empirical evidence suggests that improving access to finance and credit markets can mitigate financial constraints and prevent productivity losses (Amos & Zanhouo, 2019). Large companies necessitate domestic bank loans as a means of financing to initiate business initiatives and ventures that yield efficiency gains in terms of enhanced sales and cost reductions in manufacturing (Du & Girma, 2008). Giang et al. (2019) demonstrated that firms were able to capitalize on and enhance productivity through access to overdraft facilities and credit loans provided by banks and other financial institutions. External financing also equips firms to withstand economic and environmental crises (Thangavelu & Chongvilaivan, 2013; Gomis & Khatiwada, 2017). Finance-led growth hypothesis and neo-classical growth theory explain that for manufacturing firms to thrive and gain long-term sustainable growth, the availability of sufficient funds for firms' resource allocation and continuous technological development will be crucial for productivity in the long run.

Financial Development as to Credit Loans and Productivity Growth

According to Llanto (2012), boosting the country's productivity development requires higher government spending on human capital development, attractiveness, and openness to international investors, as well as robust macroeconomic policies and frameworks to maintain economic expansion and resilience. Currently, aggregate productivity development in the Philippines depends on intra-industry productivity. Reallocating resources to more productive tasks induces greater firm output. Empirical results show that small firms dominate businesses in the Philippines and are less productive than medium and large firms due to a lack of financing, support in technology optimization and resources, and their sensitivity to structural shocks (World Bank, 2018). Foreign ownership in the overall Philippines economy remained small but modestly higher in several service and manufacturing sectors. To improve the overall economy, export capacity must be increased owing to global competition and dwindling percentages of exporting enterprises that have chosen to focus on domestic rather than international markets (World Bank, 2018).

Furthermore, a strong financial sector is associated with a healthy economy, which explains why countries strive to maintain a strong and viable financial system. In the Philippines, the financial sector is broadly defined to include both banks and non-bank financial institutions. Due to considerable gains in total bank assets over the previous few decades, the banking industry, primarily commercial banks, has accounted for a significant component of the Philippine financial system (Milo, 2019). However, this improvement has yet to catch up with ASEAN counterparts such as Malaysia and Thailand. For example, the insurance density, as measured by current market status and insurance penetration, shows that the growth was slightly slower than that of other emerging economies. Meanwhile, the Securities and Exchange Commission, the Central Bank, and the Insurance Commission were tasked with overseeing these financial organizations' transactions and activities (Intal & Llanto, 1998; Milo, 2019).

As a result, expanding the banking sector was critical to guaranteeing long-term macroeconomic stability. However, because of the financial turmoil created by the 1998 and 2008 Asian financial crises, the required financial reforms strengthened the country's macroeconomic underpinnings to make significant contributions to the growth of the Philippines' financial sector. In addition, Intal and Llanto (1998) underlined that prudent regulation and supervision contributed to the development of a robust financial industry in the rural and urban informal sectors. This policy change happened due to the elimination of impediments that skewed credit choices, as well as the introduction of prudential laws, which resulted in the entry of international banks, the upgrading and stability of banks' capital adequacy ratios, and banking service innovations. Throughout the previous five decades, Llanto (2012) has underlined the relevance of policies related to education, human capital development, foreign participation in the local market, and solid macroeconomic fundamentals as productivity growth levers. Similarly, continuous structural and financial changes aimed at financial markets have significantly improved financial sector solidity and efficacy, resulting in the extension and accessibility of financial services in the domestic market (Dakila, 2020).

The Philippines' financial system aspires to preserve and improve financial stability, efficiency, and inclusiveness. Following the Asian Financial Crisis, the broad money ratio (M3 to GDP ratio) increased by nearly 67.3% in 2017 and 69.7% in 2019, respectively. The domestic private credit to actual sector ratio increased by 35.1% compared to the average performance of lower- and middle-income economies from 2015 to 2017 (Dakila, 2020). Moreover, the domestic credit-to-private-sector GDP ratio was 47.8% in 2017 and 50.2% in 2019. These performances were poor and lagged behind other ASEAN nations in terms of access to financial services, such as Malaysia (118.8%), Thailand (145.0%), and Vietnam (130.7%; Dakila, 2020; Milo, 2019). Despite the onset of the pandemic, the banking industry is financially sound and resilient. The banking lending rates increased by 9.6% year on year in June 2020, and the non-performing loan ratio increased by 2.5%. The capital adequacy ratios remained above the central bank's statutory level of 10.0% and the worldwide benchmark of 8.0%, respectively (Bangko Sentral ng Pilipinas, 2020).

Majority of studies in India have shown that financial development has a significant and positive effect on firm-level productivity of manufacturing enterprises via private sector access to the banking

system and the exposure of both the government and foreign sectors in the capital markets (Xu & Pal, 2011). Credit availability enabled the deployment of vital resources for reaping productivity growth in the Mexican context, as well as a significant contribution to economic output in the form of an increase in private credit-to-GDP ratios (López, 2017) . Although greater access to external finance enhanced the operations of Chinese manufacturing firms, it significantly influenced firm productivity as well (Chen, 2010). Calub (2011) used a unique measure of financial depth, liquid liabilities to GDP, to conclude that a significant long-term association exists between financial development and TFP increase in the Philippines.

Moreover, Arnold and Flach's (2017) findings explained that increasing and strengthening firms' access to credit increases additional capital resources, which results in more substantial aggregate productivity growth, especially for high-performing firms. In comparison, several companies have ventured into financial markets to investigate alternative means of resource allocation and mitigate the negative impact of limited access to financing, which can impede firm growth (Fowowe, 2017). Concurrently, financial health achieved through an organization's access to financial markets gives liquidity and commercial opportunities, allowing investment plans and activities to boost competitiveness, which promotes growth and productivity (Thangavelu & Chongvilaivan, 2013). The efficient and prolonged credit availability allows businesses to maintain a competitive market position, continuously and favorably promoting productivity development (Gatti & Love, 2006; Aghion et al., 2019). As a result, financial development via access to credit loans and other external funding significantly impacts firm-level productivity. Based on the above discussions, we hypothesize that:

H_1: Financial development proxied by access to credit loans significantly and positively affects firm-level productivity.

Other Southeast Asian studies have found that financial growth, such as credit facilities from financial institutions and bank loans, has a favorable impact on firm-level productivity (Giang et al., 2019)microfi nance institutions, and informal lenders, and hence they have some access to credit. Notwithstanding, it is found that many enterprises are credit-constrained, and so it is plausible that credit constraint or credit rationing affects the productivity of the enterprises. The access to credit is expected to be endogenously determined and in order to isolate the effect of access to credit on productivity, the endogeneity is controlled by applying instrumental variable and two stage least squares techniques. The results show that the access to credit (i. Furthermore, according to Du and Girma (2008), larger enterprises depended more on domestic bank loans because this option was highly successful and favorable in venture endeavors. Other empirical studies found that subsequent financial acquisitions resulted in efficiency advantages based on increased sales and decreased production costs (Chemmanur et al., 2011). According to Gomis and Khatiwada (2017), leverage benefits future total factor productivity and has a considerable economic impact. At the firm-level debt analysis, empirical data differs, with a beneficial influence on productivity and an increase in debt levels dampening the firm and the economy. These findings show that expanding access to corporate financing supports and enhances businesses' optimum productivity development. Based on the above discussions, we hypothesize that:

H_2: Firms with access to credit loans will experience higher productivity than those firms without access to credit loans.

Other empirical studies, on the other hand, discovered ambiguous evidence about the relationship between financial development and the rise of firm-level TFP. Equitable access to credit across companies varies in size and allocation between firms and different industries, resulting in a non-significant influence on productivity growth (Shang et al., 2017). Furthermore, Wang and Kong (2019) found that while state-owned enterprises had greater access to external finance, non-SOEs like private and foreign-owned firms employed credits on trading to enhance TFP and ease financial limitations in their cash flows. As a result, businesses have limited access to external capital and must depend on internal resources, compromising TFP growth (Chen & Guariglia, 2013). Despite these contradictory empirical findings, stagnant financial development benefits firm and sector productivity growth greatly. Similarly, to address the paucity of research that would lead to a better knowledge of the country's existing industrial and manufacturing enterprises' productivity,

the finance-productivity nexus in the Philippines context has to be further investigated.

Data and Research Methodology

Data Sources

This study used comprehensive firm-level data from the World Bank Enterprise Survey conducted on the Philippine manufacturing sector in 2015. This firm-level survey includes 731 manufacturing firms from around the country (from Metro Manila, NCR, excluding Manila, Metro Cebu, Central Luzon, and CALABARZON). Even with no time dimension, cross-sectional data can exploit models that are data- and treatment-driven to achieve useful statistical inferences. Models such as the endogenous switching technique (employed by our study) using a counterfactual framework have been used extensively (Di Falco et al., 2011; Lokshin & Sajaia, 2004) to obtain signs of causal effects and estimates. Although the debate surrounding the use of cross-sectional data for causal inference is far from settled, our paper made an important contribution in addressing the knowledge gap on the role of access to credit and its impact on productivity.

The data include continuous and categorical measures of firm-specific characteristics and other aspects, such as financial development indicators calculated in terms of access to finance and productivity growth proxied by TFP performance estimated using the Cobb-Douglas production function (Şeker & Saliola, 2018) and annual sales based on World Bank Enterprise Survey indicators.

The productivity measure was anchored on Şeker and Saliola's (2018) Cobb-Douglas productivity function with proxies consisting of YAKL (log of TFP from the residual component of the production function with predictors comprising annual labor costs and cost of capital in logarithmic form), YAKLM (logarithmic form of TFP from the residual component of the production function with additional components such as costs related to raw materials and intermediate goods in logarithmic form), and YAKLEM (logarithmic form of TFP from the residual component of the production function with the supplementary costs composing of costs related to raw materials and intermediate goods, and energy in logarithmic form). The exogenous variables include capital (proxied by the total yearly cost of capital), labor (measured based on the total yearly cost of labor), raw materials and intermediate goods (computed based on the total yearly cost of raw materials and intermediate goods), and a variable representing the TFP term. All of these given indicators are in their logarithmic form. The details of the variables' measurements are shown in Table 1.

Furthermore, the logarithm form of TFP and the logarithm form of average yearly sales in the previous three years were used as proxies of productivity growth to investigate the impact of financial development on firm productivity. As represented by credit loan availability, financial development is an endogenous variable, with firm size serving as the instrument (Table 1). R&D intensity is the ratio of R&D expenditures to annual sales; export intensity is the percentage of the establishment's sales from direct exports; and human capital intensity is the proportion of full-time permanent employees who have completed secondary school.

Finally, we use the endogenous switching method to examine firm-level productivity to determine whether firms with more access to credit loans obtained a higher level of productivity than firms that did not rely on external financing. Logarithmic forms of TFP or logs of yearly sales represent productivity measurements. The model also measures conditional expectations, treatment effects, and heterogeneity effects.

Model Specifications

To model the impact of financial development proxied by access to credit loans on firm productivity, we follow the traditional growth approach of a well-behaved production function developed by Solow (1956), which defines output as a function of total factor productivity collected residually from an equation of the form, Y = *F* (A, K, L). Our procedure to estimate the empirical model will follow **Şeker and Saliola (2018)** and Giang et al. (2017):

$$Y = AK^{\alpha}L^{\beta} \tag{1a}$$

Y is output measured as annual real sales, taken from the World Bank Enterprise Survey. Variants of Equation 1 are shown below by adding materials (M), energy (E), and value added (VAKL) to the original production function as:

Table 1. *Variables' Measurements*

Variable	Measurement	Description	Source
Y_i	Real annual sales	Calculated based on real annual sales generated by firms in the last three years	World Bank Enterprise Survey
K_i	Capital	Computed based on costs associated with net book value of machinery, vehicles, and equipment.	World Bank Enterprise Survey
L_i	Labor	Computed based on costs related to wages, salaries, bonuses, and social security payments	World Bank Enterprise Survey
M_i	Materials	Computed based on costs related to raw materials and intermediate goods	World Bank Enterprise Survey
A_i	TFP term	Estimations from the TFP term	World Bank Enterprise Survey
$Prod_i$	Productivity growth	The firm-level productivity measured by proxies of TFP and annual sales;	World Bank Enterprise Survey
$FinDev_i$	Financial development	Proxied by access to credit or external financing such as credit loan	World Bank Enterprise Survey
$R\&D\ intensity_i$	R&D intensity	Total annual cost of raw materials and intermediate goods	World Bank Enterprise Survey
$Capitalintensity_i$	Capital intensity	Measured by the net book value of assets over sales	World Bank Enterprise Survey
$Exportintensity_i$	Export intensity	Measured by the percentage of the establishment's sales from direct exports	World Bank Enterprise Survey
$Humancapitalintensity_i$	Human capital intensity	Proxied by the percentage of full-time permanent workers who completed secondary school	World Bank Enterprise Survey
$Ownership_i$	Ownership	Refers to the firm's current legal status and type of ownership	World Bank Enterprise Survey

Note(s): The variables used in the statistical estimations were transformed in logarithmic form following Seker and Saliola (2018). The data came from the World Bank Enterprise Surveys, http://www.enterprisesurveys.org/

$$Y_i\,(\mathrm{YAKL}) = A_i + K_i^{\alpha} + L_i^{\beta} \quad (1b)$$

$$Y_i\,(\mathrm{YAKLM}) = A_i + K_i^{\alpha} + L_i^{\beta} + M_i^{\phi} \quad (1c)$$

$$Y_i\,(\mathrm{YAKLEM}) = A_i + K_i^{\alpha} + L_i^{\beta} + E_i^{\gamma} + M_i^{\phi} \quad (1d)$$

$$Y_i\,(VAKL) = Y_i - M_i - E_i \quad (1e)$$

The variables include Y_i, which represents firms' value-added output (Equation 1e) computed based on the difference between overall annual sales and costs of intermediate inputs and energy on an annual basis. A_i is the TFP term (productivity) and K_i represents the yearly cost of capital proxied by the net book value of vehicles, machinery, and equipment. L_i is the total yearly cost associated with labor comprising social security payments, salaries, bonuses, and wages, and M_i represents the total yearly cost related to raw materials and intermediate goods. Lastly, E_i represents the total cost associated with energy. Furthermore, the parameters such as α, β, γ, and ϕ reflect the factor elasticities obtained from capital, labor, energy, and materials, respectively. Applying logs to Equations 1a, 1b, 1c, & 1d yields:

$$Ln\hat{A}_{it} = LnY_{it} - \hat{\alpha} lnK_i - \hat{\beta} lnL_i \quad (2a)$$

$$Ln\hat{A}_{it} = LnY_{it} - \hat{\alpha} lnK_i - \hat{\beta} lnL_i - \hat{\phi} lnM_i \quad (2b)$$

$$Ln\hat{A}_{it} = LnY_{it} - \hat{\alpha} lnK_i - \hat{\beta} lnL_i - \hat{\gamma} lnE_i - \hat{\phi} lnM_i \quad (2c)$$

$$Ln\hat{A}_{it} = LnY_{it} - \hat{\alpha} lnK_i - \hat{\beta} lnM_i - \hat{\gamma} lnE_i \quad (2d)$$

Estimated log transformation of Equations 2a, 2b, 2c, and 2d forms TFP or firm productive calculated as the difference between log output and log inputs used in the estimation process.

The impact of financial development on firm productivity was investigated using a three-step process: regress TFP on financial development and other firm characteristics using ordinary least squares (OLS), use alternative specification of instrumental variable regression, and finally use endogenous switching regression to estimate the relation between financial development and productivity.

We specify and estimate OLS models (1 to 4) using TFP obtained from Equations 2a – 2d as follows:

$$\begin{aligned} LnProd_i(TFP = sales) = {} & \beta_0 + \beta_1 LnFinDev_i + \\ & \beta_2 R\&Dintensity_i + \beta_3 Capitalintensity_i + \\ & \beta_4 HumanCapital\ intensity_i \\ & + \beta_5 Exportintensity_i + u_i \end{aligned} \quad (3a)$$

where u denotes an error term plus five explanatory variables defined in Table 2.

Estimating the link between financial development and productivity, as shown in Equation 3a, can be fraught with econometric error due to endogeneity (Gatti & Love, 2006; Butler & Cornaggia, 2011) and provides the justification for instrumental variable regression.

Due to the assumption of endogeneity of financial development in Equation 3a, we rewrite the equation as:

$$Y_i = \beta_o + \beta X_i + W\beta + u_i \quad (3b)$$

where Y, X, $\boldsymbol{W}$, and u denote ln(annual sales = productivity), ln(FinDev), the vector of explanatory variables, and the error term respectively. A suitable instrument for financial development (FinDev) is $FirmSize_i$ because it fulfills the three basic requirements of instrument (Z):

(1). The instrument Z does not appear in the equation model (3a);
(2). The instrument Z is correlated with the endogenous variable, X (FinDev), so that $[\mathrm{cov}(z, x) \neq 0]$.
(3). The instrument Z is uncorrelated with the error term, u, that is, $[\mathrm{cov}(z, u) = 0]$.

In estimating the impact of financial development (measured as access to credit) on productivity, we looked for possible sources of exogenous variation in financial development. Although we do not discount the possibility that other sources of variation in financial development may exist, we determined that firm size is a source of variation in financial development. Our selection of firm size rests on the premise that a good instrument should correlate with the endogenous variable (in our case, financial development). Firm growth has been determined to be associated with external funding, and firm size may determine both the need for finance and access to funds (Kumar et al. 1999). Firm size is an important variation in financial development in that funding can constrain the growth of a firm. In the Philippines, Flaminiano and Francisco (2021) have shown that in the case of SMEs, the ease of access to finance is correlated with firm size, which means that firm size can affect access to credit, which in turn affects firm performance.

The reduced form of Equation 3b with instrument $FirmSize_i$ was estimated with financial development to credit loans as a dependent variable to obtain the fitted values of financial development as:

$$\begin{aligned} FinDev = {} & \alpha_0 + \alpha_1 R\&Dintensity_1 + \\ & \alpha_2 Capitalintensity_2 + \\ & \alpha_3 HumanCapitalintensity_3 + \\ & \alpha_4 Exportintensity_4 + \alpha_{k+1} FirmSize_1 + \varepsilon_i \end{aligned} \quad (4a)$$

Lastly, after addressing the endogeneity issue by replacing the endogenous financial development with the fitted form financial development variable (i.e., incorporating the instrument), the final model specification yields:

$$\begin{aligned} LnProd_i(annual\ sales) = {} & \beta_0 + \beta_1 \widehat{FinDev}_i + \\ & \beta_2 R\&Dintensity_i + \beta_3 Capitalintensity_i + \\ & \beta_4 HumanCapital\ intensity_i + \\ & \beta_5 Exportintensity_i + u_i \end{aligned} \quad (4b)$$

The endogenous switching model approach was used in the last phase to determine if firms that used financial services such as credit loans outperformed firms that did not use credit loans. This method was inspired by Lokshin and Sajaia's (2004) two-stage endogenous switching technique. The endogenous switching regression equation is shown below.

$$\ell_i = \alpha Z_i + \eta_i \ with \ \ell_i = \begin{cases} 1 \ if \ \ell_i > 0 \\ 0 \ otherwise \end{cases} \quad (5)$$

Where ℓi is a latent variable that takes the value 1 ($FinDev_i$ =1) if firm i has credit access and 0 $FinDev_i$ =0) otherwise, Zi is a vector of firm-level characteristics that impact a firm's choice to borrow from a bank or any financial institution or simply credit access, α is a vector of parameters to be estimated, η_i is an error term in the selection equation.

On the other hand, $X_i s$ are set indicators of firm characteristics that impact a firm's choice to borrow from a bank (access to credit). As shown in Equation 5, Z_i^* indicates the instruments influencing the choice to obtain a credit loan. The endogenous switching regression model considered selection biases in firms' binary decisions to access credit loans or not to access credit loans. These binary decisions serve as the endogenous switch model, resulting in a two-equation regime from Equations 6 and 7— β_{1i} and β_{2i} are the parameter estimates and ε_{1i} and ε_{1i} are the error terms. The firms must choose between two regimes: (a) access to credit loans and (b) non- access to credit loans. Given the option of accessing or not accessing, two regime equations may represent the observed productivity of firms.

$$\text{Re}gime\ 1 : (FedDev_i = 1) = \text{Pro}d_{1i} = \beta_{1i} X_{1i} + \varepsilon_{1i} \quad (6)$$

$$\text{Re}gime\ 2 : (FedDev_i = 0) = \text{Pro}d_{2i} = \beta_{2i} X_{2i} + \varepsilon_{2i} \quad (7)$$

The econometric issue with Equations 6 and 7 is that the X's captures selection bias for observed factors rather than unobserved factors. The remedy is to estimate Equation 5 using probit and then calculate the inverse Mills ratios (IMRs) following literature (Lokshin & Sajaia, 2004). Inverse Mills ratios for the two regimes can be calculated following literature (Lokshin & Sajaia, 2004; Frondel & Kussel, 2019:

$$IMRs_{1i}(\lambda_{1i}) = \frac{\phi(Z_i\alpha)}{\Phi(Z_i\alpha)}, \qquad IMRs_{2i}(\lambda_{2i}) = \frac{\phi(Z_i\alpha)}{1-\Phi(Z_i\alpha)} \quad (8)$$

where φ(.) is the standard normal probability density function and Φ(.) is the standard normal cumulative density function. Adding IMRs to Equations 6 & 7 yields the following:

$$\text{Pro}d_{1i} = X_i\beta_{1i} + \sigma_{1\eta}\lambda_{1i} + \nu_{1i} \quad if \ FinDev_i = 1 \quad (6a)$$

$$\text{Pro}d_{2i} = X_i\beta_{2i} + \sigma_{2\eta}\lambda_{2i} + \nu_{2i} \quad if \ FinDev_i = 0 \quad (7a)$$

Where $\sigma_{1\eta}$ is the covariance of η_i and ε_{1i}; $\sigma_{2\eta}$ is the covariance of η_i and ε_{2i}; and $v_1 i$ and $v_2 i$ are the random disturbance terms. The IMRs used to augment Equations 6a and 7a control for selectivity bias due to unobserved factors that may affect both the decision to access credit loans and firm productivity.

The selection problem is said to occur when the error term (η_i) in the selection in Equations 5 and 6 correlates with the error terms ε_{1i} and ε_{2i} for productivity functions in Equations 6 and 7, respectively. This implies that the characteristics of firms have an effect on the propensity to choose to access credit loans and productivity, making the estimates derived from β_i biased. The error terms of the two regimes Equations 6 and 7; and the selection in Equation 5 are assumed to have a tri-variate normal distribution, with zero mean and covariance matrix **Ω**, that is, (ε_{1i} ε_{2i} η_i) N (0 **Ω**):

$$\Omega = \begin{bmatrix} \sigma_1 & . & \sigma_{1\eta} \\ . & \sigma_2^2 & \sigma_{2\eta} \\ . & . & \sigma_\eta^2 \end{bmatrix},$$

where σ^2_η is the variance of the error term in the selection equations and assumed to be scaled to factor 1, σ^2_1 and σ^2_2 are the variances of the error terms in the regime Equations 6 and 7, respectively (Lokshin & Sajaia, 2004; Lokshin & Sajaia, 2011). The $\sigma_{1\eta}$ and $\sigma_{2\eta}$ represents the covariance of η_{1i} and ε_{1i} and ε_{2i}. From the covariance matrix, $\sigma_{1\eta}$ is the covariance of η_i and ε_{1i}, and $\sigma_{2\eta}$ is the covariance of η_i and ε_{2i}. This covariance relationship is the main argument for jointly estimating selection and regime equations (Lokshin & Sajaia, 2004; Lokshin & Sajaia, 2011; Maddala, 1983).

Given the error structure, OLS estimates will be biased because the error term of the selection equations **ηi** is correlated with the error terms of the regime (productivity) equations ($\boldsymbol{\varepsilon}_{1i}$ and ε_{2i}), which results in the expected values of ε_{1i} and ε_{2i} conditional on the sample selection to be nonzero (Di Falco et al., 2011). A statistically significant test of the estimated covariances will imply that access to credit loans and productivity are correlated, which justifies endogenous switching regression rather than the standard OLS (Di Falco et al., 2011; Frondel & Kussel, 2019).

The full information maximum likelihood (FIML) estimation was used to implement endogenous

switching regression for this study (Di Falco et al., 2011; Lokshin & Sajaia, 2004). The correlation coefficients computed from FIML can be expressed as follows:

$$\rho_1 = \frac{\sigma_{1\eta}^2}{\sigma_\eta \sigma_1} \quad , \quad \rho_2 = \frac{\sigma_{2\eta}^2}{\sigma_\eta \sigma_2}$$

where $\rho 1$ (rho1) is the correlation coefficient between the error term of the selection equation (η_i) and the error term of the productivity equation (ε_{1i}) when FinDev is equal to 1, and $\rho 2$ (rho2) is the correlation coefficient between the error term of the selection equation (η_i) and error term of the productivity equation (ε_{2i}) when FinDev is equal to 0.

Parameter estimates of endogenous switching regression (ESR) can be used to compute conditional expectations or expected outcomes (Lokshin & Sajaia, 2004):

For firms that availed of credit access:

$$E(prod_{1i}|credit_i = 1, X_{1i}) = \beta_1 X_{1i} + \sigma_{1\eta}\rho_1 \frac{f(\alpha Z_i)}{F(\alpha Z_i)} \quad (9)$$

For firms that did not avail of financial access had they decided to avail (counterfactual):

$$E(prod_{2i}|credit_i = 0, X_{2i}) = \beta_1 X_{2i} - \sigma_{2\eta}\rho_1 \frac{f(\alpha Z_i)}{(1-F(\alpha Z_i}} \quad (10)$$

For firms that availed of financial access had they decided not to avail (counterfactual):

$$E(prod_{2i}|credit_i = 1, X_{2i}) = \beta_2 X_{1i} + \sigma_{2\eta}\rho_2 \frac{f(\alpha Z_i)}{F(\alpha Z_i)} \quad (11)$$

For firms that did not avail of credit access:

$$E(prod_{2i}|credit_i = 0, X_{2i}) = \beta_2 X_{2i} - \sigma_{1\eta}\rho_2 \frac{f(\alpha Z_i)}{(1-F(\alpha Z_i)} \quad (12)$$

where f = probability density, F = cumulative distribution function of the standard normal distribution; and $\rho 1$ and $\rho 2$ are correlation coefficients defined earlier.

The productivity expectations of the firms are shown in Equations 9, 10, 11, and 12. $Prod_{1i}$ indicates whether a firm used credit loans (1), or , $Prod_{2i}$ (0) if a firm did not use credit loans. The treatment effects used in the analysis illustrate the influence of the treatment (credit loan) on the treated (firms that utilized credit loans), represented by *TT*. The impact of the treatment (credit loan) on the untreated (i.e., firms that decided not to use credit loans) is represented by *TU*. Furthermore, BH_i shows the impact of base heterogeneity on firms that accessed credit loans ($FinDev_i$= 1), and firms that did not access credit loans ($FinDev_i$= 0). Finally, *TH* difference explains the impact of transitional heterogeneity (*TT* – *TU*).

The equations for conditional expectations, treatment effects, and heterogeneity estimations are illustrated as follows:

$$TT = E(Prod_{1i}|FinDev_i = 1) - E(Prod_{2i}|FinDev_i = 1) \quad (13)$$
$$TU = E(Prod_{1i}|FinDev_i = 0) - E(Prod_{2i}|FinDev_i = 0) \quad (14)$$
$$BH_1 = E(Prod_{1i}|FinDev_i = 1) - E(Prod_{1i}|FinDev_i = 0) \quad (15)$$
$$BH_2 = E(Prod_{2i}|FinDev_i = 1) - E(Prod_{2i}|FinDev_i = 0) \quad (16)$$

Results and Discussion

Table 2 reports the mean and standard deviation of values productivity indicators (YAKL, YAKLM, YAKLEM, VAKL, and annual sales) used in this

Table 2. *Descriptive Statistics Showing Average Levels of Productivity*

Productivity Indicators	Mean	Standard Deviation
Productivity as to TFP:		
TFP (YAKL)	0.775	0.445
TFP (YAKLM)	0.669	0.281
TFP (YAKLEM)	0.703	0.266
TFP (VAKL)	0.446	0.428
Productivity as to Sales:		
Annual Sales	7.721	0.925

Note(s): The variables used in the statistical estimations were transformed in logarithmic form following Seker and Saliola (2018). The data came from the World Bank Enterprise Surveys, http://www.enterprisesurveys.org/

Table 3. *Credit Loan Acquisitions of Manufacturing Firms in the Philippines*

Credit loan	Frequency count	Percentage	Cumulative Percentage
No	192	57.83	57.83
Yes	140	42.17	100.00
Total	332	100	

Note(s): No. of observations = 332; The descriptive results are presented in percentage form. The data came from the World Bank Enterprise Surveys, http://www.enterprisesurveys.org/

study across the entire sample based on Şeker and Saliola (2018) productivity equation. The average levels of productivity shown in Table 2 are similar to productivity values in Southeast Asia. The empirical results for average productivity increase in Southeast Asian manufacturing in terms of total factor productivity (TFP) is 0.648 percentage points with a standard deviation of 0.355. We found that, in terms of sales productivity, our value of 7.721 percentage points with a standard deviation of 0.925 is similar to the findings of Şeker and Saliola (2018) pertaining to the average productivity performance of manufacturing firms in Southeast Asia.

Table 3 shows that roughly 57.83% of manufacturing firms did not acquire credit loans from financial institutions. The remaining 45.28% utilized this form of external finance to supplement their respective financial capacity. These findings were consistent with actual data investigations that found that most manufacturing did not depend on credit loan acquisitions (Ezzahid & Elouaourti 2018).

In addition, empirical data reveal that access to credit loans for manufacturing firms has a positive and significant influence on firm-level productivity (measured in terms of yearly sales), as shown in Table 4. These findings suggested that for every percentage increase in access to a credit loan, manufacturing businesses might generate a 3.99% gain in productivity. As a result of this discovery, increasing firms' access to capital will increase their efficiency in terms of more sales, cheaper production costs, and optimal productivity growth. Finally, this conclusion was consistent with the empirical research, which revealed that access to financing for businesses through credit or bank loans provided by financial institutions positively increased firm-level production (Giang et al., 2019obtaining financial services at affordable rates and fair terms has been a significant challenge for small and medium enterprises (SMEs).

Table 5 shows the result of the diagnostic test carried out to validate the model. The results suggest that the models of financial development and proxies of firm-level TFP were all fitted, as indicated by the statistical values presented. The diagnostic results revealed that the models were robust both in terms of under-identification and weak identification of model specifications. The endogenous regressor represented by the credit loan revealed that it was identically suitable, as reflected by the high level of statistical significance. However, the heteroskedasticity test specified homoscedastic or constant variance across the values of productivity (Table 5).

Table 6 reports the results of ESR, which indicates the presence of endogeneity between access to credit loans and firm productivity (that is, the equations are dependent on each other, meaning independent variables used jointly influence access to credit loans and its impact on the productivity of firms with access to credit loans and firms without access to credit loans.), as shown by the highly significant p-value of the likelihood ratio test for joint independent equations (chi-square statistic of 12.73). The correlation coefficients of the rho term 1 (ρ1) and rho term 2 (ρ2) of the error terms of the selection equation model (Equation 5) and the productivity Equations (6 & 7) between firms with access to credit loans and their counterparts without access to credit loans are both negative and significantly different from zero only for firms without access to credit. This implies the presence of selection bias, that is, the existence of unobserved factors that could render estimates unreliable if overlooked (Lokshin & Sajaia, 2004). However, the negative and significant sign suggests

Table 4. *OLS and Instrumental Variable Regression Results*

Indicators	Dependent variable:		TFP		Annual Real Sales
			OLS		IV
	Model 1: (YAKL)	Model 2: (YAKLM)	Model 3: (YAKLEM)	Model 4: (VAKL)	Model 5:
Financial development:					
Credit loan	-0.0536	0.122	0.0001	-0.00266	3.999***
	(0.207)	(0.148)	(0.138)	(0.208)	(1.020)
Independent variables:					
R&D intensity	-0.296***	-0.186***	-0.222***	-0.304***	1.246***
	(0.0652)	(0.0436)	(0.0397)	(0.0606)	(0.347)
Capital intensity	-0.0955***	-0.0301***	-0.0239***	-0.0749***	0.0134
	(0.0276)	(0.00780)	(0.0082)	(0.0222)	(0.0454)
Human capital intensity	0.301***	0.0926	0.0413	0.193*	1.534***
	(0.0905)	(0.0653)	(0.0613)	(0.104)	(0.475)
Export intensity	0.0112	0.0796	0.0505	0.0301	0.882**
	(0.0750)	(0.0528)	(0.0478)	(0.0679)	(0.344)
Constant	0.604***	0.547***	0.6782***	0.330**	4.502***
	(0.153)	(0.100)	(0.0946)	(0.160)	(0.714)
Observations	332	332	332	332	332
F statistic	15.03***	17.52***	18.73***	21.87***	6.585***
Centered R-squared	0.183	0.0411	-0.0859	0.126	-2.990
Uncentered R-squared	0.798	0.856	0.8648	0.581	0.944
Root MSE	0.402	0.275	0.2673	0.400	1.844

*Note(s): All of the variables presented are calculated in log form. The estimation models include Model 1 (YAKL), Model 2 (YAKLM), Model 3 (YAKLEM), Model 4 (VAKL), and Model 5 (Annual real sales). The first numbers shown were the coefficients of the indicators, while the robust standard errors are shown in parentheses. P-values significance levels were presented with *** p<0.01, ** p<0.05, * p<0.1. data came from the World Bank Enterprise Surveys, http://www.enterprisesurveys.org/*

Table 5. *Instrumental Variable Regression Model Diagnostic Results*

Diagnostic Test Statistic	ANNUAL SALES
Under-identification test	14.242***
Weak identification test	14.800
Endogeneity test of endogenous regressors	45.888***
Heteroskedasticity test	5.893

*Note: All of the given variables are computed based on log form. The first numbers shown were the coefficients of the indicators, while the robust standard errors are shown in parentheses. P-values significance levels were presented with *** p<0.01, ** p<0.05, * p<0.1. The test statistics were based on the following tests: Kleibergen-Paap rk LM statistic for under-identification test; Kleibergen-Paap rk Wald F statistic for weak identification test; Chi-square statistic for endogeneity test of regressors; and Pagan-Hall general test statistic for heteroskedasticity test.*

*[**exogeneity** of financial development in the sales equation is supported in table 5]*

that firms without access to credit loans tend to have above-average productivity than a random firm in the sample and are better off without access to credit loans; firms with access to credit loans tend to be neither better nor worse off productivity-wise on the average than a random firm in the sample and are better off having access to credit loans (Lokshin & Sajaia, 2004; Wu, 2022). The results also show notable differences between the two groups of firms: with access to credit and without access to credit loans. Firm ownership is negatively and significantly related to productivity for firms that did not avail of credit loans, suggesting that foreign-owned firms are less likely to seek domestic credit loans than their local counterparts. This may be attributed to the availability of alternative sources of credit from parent firms or other international networks of financial organizations (Dimelis & Louri, 2002). Export intensity has a positive and significant relationship with productivity for firms that did not avail of credit loans. The findings imply that export intensity jointly determines the likelihood of non-access to credit loans and productivity. Lastly, human capital intensity is significantly and positively associated with productivity regardless of whether firms have access to credit loans or not. This result supports the key role education and training play in productivity growth, as documented by many studies (Liu & Bi, 2019; Park, 2012; Botrić et al., 2017; Satpathy et al., 2017).

Table 7 shows the average firm productivity under actual and counterfactual conditions for firms with access to credit and without access to credit loans. In cell (a), the predicted firm-level productivity of firms that accessed credit loans was 8.044 percentage points, whereas in cell (b), the expected productivity of those firms that did not use credit loans was around 8.717 percentage points. Meanwhile, cells (c) and (d) showed firm-level productivity counterfactual

Table 6. *Endogenous Switching Method Results for Credit Loan and Firm-Level Productivity*

VARIABLES	(1) Firm-level productivity (sales) with credit loan	(2) Firm-level productivity (sales) without credit loan
Industry	0.0176	0.0108
	(0.0305)	(0.0291)
Ownership	-0.103	-0.235***
	(0.0810)	(0.0732)
Capital intensity	-0.1520	-0.0286
	(0.0987)	(0.0319)
Human capital intensity	1.021***	1.009***
	(0.319)	(0.303)
Export intensity	0.254	0.600***
	(0.256)	(0.193)
Constant	7.891***	6.659***
	(0.530)	(0.440)
Observations	332	
ρ_1, ρ_2	-.497(.268)	-.873(.058)***
Log likelihood	-605.68788	
Wald X^2	22.08***	
LR test of independent equations X^2	12.73 ***	

*Note: All of the given variables are computed based on log form. The first numbers shown were the coefficients of the indicators, while the robust standard errors are shown in parentheses. P-values significance levels were presented with *** p<0.01, ** p<0.05, * p<0.1. The data were gathered from the Enterprise surveys of the World Bank (http://www.enterprisesurveys.org).*

Table 7. *Conditional Expectations, Treatment, and Heterogeneity Effects of Credit Loan to Firm-Level Productivity*

Subsamples	Decision Stage		
	To Avail	Not to Avail	Treatment Effects
Firms with access to credit loan	(a) 8.044	(c) 7.487	TT = 0.557
Firms without access to credit loan	(d) 5.993	(b) 8.717	TU = -2.724
Heterogeneity Effects	BH_1 = 2.051	BH_2 = -1.23	TH = 3.281

Note: (a) and (b) depict the actual observed expectation samples, whereas (c) and (d) are the outcomes that are counterfactual. This modified method is anchored with Lokshin and Sajaia's (2004) endogenous switching approach.

possibilities. Cell (c) shows that firms with access to credit loans would have a firm-level productivity of 7.487 percentage points or about 1.07 times less if they did not have access to credit loans. Cell (d) shows that firms without access to credit loans would have had significantly lower firm-level productivity of 5.993 percentage points or 1.45 times less if they had accessed credit loans.

Finally, firms that utilized (treatment) credit loans increased their average productivity by 0.557 percentage points (or an increase of 6.9%). This implies that firms with access to credit potentially enjoyed a productivity-increasing effect of about 7%. On the other hand, firms that do not use credit loans would potentially incur decreased average productivity by 2.724 percentage points (or a decrease equivalent to 31%) if they use credit loans. This implies that firms without access to credit would have been worse off had they used credit loans. This finding could imply that access to finance is not always a cure for all firms. Overall, the transitional heterogeneity effect (3.281 percentage points); the last column of Table 7 implies that credit access benefits firms that availed of it. Additionally, if both groups do not have access to credit loans, firms currently with access to credit loans would have had 1.23 percentage points lower productivity on average compared to firms that do not currently have access to credit. Similarly, if both groups had access to credit loans, those firms currently with credit loans would have had higher productivity of about 2.1 percentage points on average than their counterpart firms that do not currently have access to credit loans. In sum, firms' credit loan utilization helped improve average productivity growth. This result is consistent with Giang et al.'s (2019) findings, which suggest that having access to credit loans may help sustain firm-level productivity.

Conclusion and Implications

This paper used the World Bank Enterprise Survey conducted on the Philippine manufacturing sector to assess the link between access to credit loans and firm-level productivity. We employed endogenous switching regression to account for unobservable factors that influence productivity and the decision to access credit loans or not to access credit loans, which may bias parameter estimates if uncontrolled. The results confirm important differences between the firms with access to credit and their counterparts without access to credit. Firm ownership is negatively and significantly related to non-access to credit loans, which suggests that domestic firms are more likely to access credit loans than their foreign counterparts. On the other hand, export intensity has a positive and significant relationship with non-access to credit loans. Human capital intensity is significantly and positively associated with both access to credit loans and non-access to credit. After controlling for self-selection bias and heterogeneity effects between firms with access to credit loans and without access to credit loans, a productivity-increasing effect exists due to access to credit loans. On the other hand, firms that did not access credit loans tend to have higher average productivity.

Under the counterfactual case predictions, if the firms that actually accessed credit loans do not avail of the credit, their productivity will decrease by 6.9%. If firms that do not have credit loans access credit loans, productivity will decrease by 31%. It is striking that access to credit loans can be both productivity-increasing and productivity-decreasing for two groups of firms in the Philippine manufacturing sector.

Our findings provide helpful insights for policymaking. Due to the positive relationship between human capital for the two groups of firms, credit access

and non-credit, policies influencing education may significantly boost productivity. Furthermore, given the importance of access to credit loans to productivity for some firms, it is particularly important for policymakers to continue to support credit availability directly or indirectly through government programs. Lastly, policymakers' efforts promoting export strategy may increase productivity.

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