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**ACCESS TO FORMAL CREDIT
AND ENTERPRISE PERFORMANCE IN NIGERIA:
A GENDER PERSPECTIVE**

The main focus of this study is to ascertain the impact of access to formal credit on enterprise performance. The study uses Nigerian Enterprise Surveys data for 2010 to construct a direct measure of credit constraint. From propensity score estimations, the results show that access to formal credit matters and has a significant impact on enterprise performance indicators. Firms that are credit constrained have significantly lower output per worker, capital per worker, employment of labour and investment in fixed assets for expansion compared to firms that are not credit constrained. This is more pronounced for women-owned enterprises after adjusting for bias in the estimations and controlling for sampling weights. This suggests that one way to support the growth of enterprises in Nigeria is to make access to formal credit less stringent. Also, government and monetary authorities should support credit expansion policies for medium and small enterprises in Nigeria.

Keywords: entrepreneurs, gender, credit, constraint, access, performance, propensity score matching

JEL Classification: O16, O17, P27

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1. INTRODUCTION

The importance of women entrepreneurs and access to finance in national development have been well documented in the literature, both in developed and developing economies (Asiedu et al., 2013; Aterido et al., 2011 and Ayyagari et al., 2007). Thus, in the last two decades, the Nigerian economy has seen the increasing participation of female entrepreneurs operating at the small and medium enterprise (SME) level. For example, a survey carried out by the Small and Medium Enterprises Development Agency of Nigeria (SMEDAN) in 2010, shows that the total number of enterprises in Nigeria stood at 17,284,671 (micro – 17,261,753, small – 21,264 and medium – 1,654). The total number of persons employed by the Micro, Small and Medium Enterprises (MSME) sector stood at 32,414,884 as of December, 2010. Of this number, female entrepreneurs account for 42.1 percent of the owners of micro enterprises, and 13.6 percent of the

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owners of small and medium enterprises. The SMEDAN survey shows that MSMEs contribution to the nation's gross domestic product in nominal terms stood at 46.5 percent as at the period under review. The survey also highlighted that access to finance in formal credit markets in Nigeria is one of the priority areas where MSMEs need assistance.

The Nigerian credit market can be broadly categorized into formal and informal sectors, based on how structured the lending process is. The better-organized and formal sector of the credit market is driven largely by the deposit money banks (DMBs). Although the capital market and other financial markets like micro finance banks are also part of the formal credit market, the DMBs dominate the market. Most of the credit granted by deposit money banks is of a short term nature (CBN, 2010). The informal credit market in Nigeria includes money lenders, Self-Help Groups (SHGs), Rotating Savings and Credit Associations (ROSCAs), relatives and friends. In order to enhance the flow of financial services to micro, small and medium enterprises in the country, the Federal Government of Nigeria launched the new Microfinance Policy, Regulatory and Supervisory Framework in 2005. This policy document was subsequently reviewed in 2011 (CBN, 2012). Despite the recent policy review, a few problems still plague the sector. The key ones include the location of Micro Finance Banks (MFBs), financing and the rates of interest charged. Some studies like Abiola (2011) and Orodje (2012), suggest that the levels of interest rates charged by the MFBs in Nigeria are too high, ranging from 20% to over 50%. This makes it very difficult for many micro and medium scale business owners to seek for or access loans from the MFBs.

That notwithstanding, where the entrepreneurs are able to access lines of credit, it is still not clear if such access has any significant impact on the performance of such enterprises in Nigeria. Thus, access to credit and enterprise performance in Nigeria and other Sub-Saharan African countries has really been an issue of serious concern. Several other constraints identified to exist among the MSMEs and the formal credit markets in Nigeria and other Sub-Saharan African countries include among others: poor credit penetration, issue of collateral, complex application procedure, asymmetric information (Asiedu et al., 2013).

This study therefore contributes to the empirical literature by investigating and analyzing the impact of credit on enterprise performance in Nigeria using a gender perspective. This study is important to Nigeria and other developing/developed countries seeking to give women entrepreneurs the required support to enable them to access credit more easily and also

grow their enterprises more significantly. Thus we argue that the findings of this study can be replicated or utilized by such countries who desire to really investigate the impact of access to credit on the performance of enterprises in their economies, paying particular attention to women-owned firms. This perspective and other arguments raised in this paper constitute the justification for this study.

2. REVIEW OF THE LITERATURE AND IDENTIFIED RESEARCH GAPS

Following an extensive review of the literature¹ on women entrepreneurship and access to formal credit, what we have learnt from existing studies is that there is no clear conclusion on the impact of access to credit from formal credit markets and enterprise performance. Thus, the mixed results in the literature suggest that the argument of whether or not access to formal credit improves the performance of women entrepreneurs especially in developing countries, still remains an empirical issue. For example, authors like Nikaido et al. (2015), Winker (1999) and Ojah et al. (2010) argue that access to relevant credit enhanced enterprise performance, and SMEs that are financially constrained find it hard to invest in fixed capital and also lack the capabilities to innovate. Similarly, Ayyagari et al. (2007) show that enterprises perform better and innovate at a faster rate if they have access to external financing. In another study, Buyinza and Bbaale (2013) investigate the factors influencing manufacturing firms' access to credit and the effect of credit constraints on firms' performance in the East African Community (EAC) using the World Bank (2006) enterprise survey for five EAC countries. They adopted simple probit, simple OLS, Tobit, and a two-step probit models. The result shows that having access to credit and a long loan duration increase firms' performance, while an increase in the annual interest rate reduces firms' productivity. This finding is also supported by the work of Radulescu (2010) for 28 Eastern European (CEE) and the former Soviet Union (CIS) countries, Bruhn (2009) for Latin America and Aterido et al (2007) for 107 countries. These studies generally argue that access to formal credit enhances firms' performance while low access to finance and ineffective business regulations reduce the growth of firms, particularly micro and small ones. Although Bruhn (2009) supports the argument that access to credit enhances firms performance, however

1 See the summary table of the literature review at the appendix (Table A7)

their empirical results show specifically that in Latin America, female-owned firms do not have less access to external finance than male-owned firms. Again, female owners are no more likely to perceive a host of institutional and market related factors to be obstacles to the firms' operation and growth than male-owned firms. The only significant difference in perceived obstacles is that female firm owners are up to 50 percent more likely than male firms owners to report that having to care for children and household obligations poses an obstacle to a firm's operation and growth. This paper is related to Sabarwal and Terrell (2009), who examined the performance of female-owned firms in Eastern Europe and Central Asia.

Further analysis by Rotich et al. (2015), using a multiple regression approach, show that increasing provision levels of access to credit and micro finance will result in the increased performance of micro enterprises in Kenya. Also the study finds that access to credit, savings, managerial training and a loan grace period is statistically significant in determining the performance of MSMEs. This result is also in agreement with the works of Opoku-Mensah and Agbekporu (2015) for Ghana, and Ocholah et al. (2013) for Kenya. Moreover in South Africa, Machirori (2012) investigates the impact of networking on access to finance and the performance of small and medium enterprises (SMEs) in the Buffalo City Municipality in the Eastern Cape Province of South Africa. The results indicate that there is a positive relationship between networking and access to finance and the performance of SMEs. In another study, Casey and O'Toole (2013) examined whether bank-lending constrained SMEs are more likely to avail themselves of alternative forms of external finance and the impact of access to alternate external finance on business fixed investment and innovation using a probit model. The study which was conducted for all Eurozone economies within the crisis period finds that bank-lending constrained SMEs are significantly more likely to avail themselves of alternative forms of external finance, controlling for firm-level and country-level characteristics. The results also show that access to alternative finance substantially reduces the likelihood of business fixed investment. This effect is not evident for business innovation. Mach and Wolken (2012) examined the effects of credit availability on small firm survivability over the period 2004 to 2008 for non-publicly traded small enterprises in the US. They find that credit constrained firms were significantly more likely to go out of business than non-constrained firms. Moreover, credit constraint and credit access variables appear to be among the most important factors predicting which small U.S. firms went out of business during the 2004-2008 period, even though an

extensive set of firm, owner, and market characteristics were also included as explanatory factors. Ismael (2013) examined the empirical relationship between credit terms, credit accessibility and the performance of agricultural cooperatives in Rwanda. The result shows the positive and significant relationship between credit terms, credit accessibility and the performance of agricultural cooperatives.

More empirical support of a link between credit access and SME performance comes from Boissay and Gropp (2007), who argue that firms that are confronted with a finance shortage try to overcome this situation by passing on one fourth of the shock to their suppliers by taking more trade credit. Other authors such as Canepa and Stoneman (2008), equally emphasize that limited access to external finance negatively affect small firms' decisions to invest in fixed capital and research and development, which subsequently limit their growth, innovativeness and performance. Aghion et al. (2007) further document that access to external financing promotes the new entry of small firms to take advantage of growth opportunities in the expanding sectors and helps small firms to compete with large firms on a more level playing field in business. Other studies that find a positive relationship between credit access and SME performance include Bougheas et al. (2009), Bigsten and Soderbom (2005), Angelini, Di Salvo and Ferri (1998), among others.

On the other hand, some studies have found a negative or weak link between credit access and SME performance. For example, White, Maru and Boit (2015) examined the relationship between firms' access to financial resources and the performance of women-owned and men-owned SMEs in Kenya using descriptive and inferential statistics. The study, which revealed that access to financial resource had no significant correlation with firm performance, also showed that all the predictors accounted for 66.5% variation in the performance of SMEs. Similarly, Atandi and Wabwoba (2013) show that access to credit or credit availability does not guarantee a bigger market share or better performance by MSMEs in Kenya. The effect of credit available to MSMEs on business performance by considering stock levels held also revealed that little money was allocated to purchase additional stock. Again, on establishing the impact of credit available to MSMEs by considering the additional number of employees, it was found that credit access to MSMEs does not necessarily lead to a good performance. Furthermore, Kang and Stulz's (2000) results from a sample of Japanese SMEs indicate the better performance for SMEs not financed by banks compared to firms with high level of bank debt. Li, Lu and Yang

(2013) examined the impact of credit on SME performance in China. Ordinary least squares estimations show that credit access is positively correlated with firms' performance. However, after including instrumental variables to tackle potential endogeneity issues, credit access no longer has any impact. Similarly, Nguyen and Vu (2013) show that if SMEs establish firmly short-term credit financing relationship with banks, the firm's performance reduces in Vietnam. Other studies which found a negative or weak link between credit access and SME performance include Degryse and Ongena (2001) for Norway; and Fok, Chang and Lee (2004) for Taiwan.

Other strands of literature dealing with the gender gap or discrimination in access to formal credit have also shown conflicting results across different economies. There is no universal agreement that men-owned enterprises are more favoured than female-owned enterprises and vice versa. However, empirical evidence shows that the issue of credit constraint depends on the economy, the sample and the methodology for analysis. Specifically, studies such as Naranchimeg and Bernasek (2013) for the USA, Beck et al. (2011) for Albania, and Annim and Arun (2013) for Ghana and South Africa, show that there is a gender gap and discrimination in access to the formal credit market, while other studies such as Camara, et al. (2014) for Senegal, and Aterido et al. (2011) for nine Sub-Saharan African countries, argue that there is no evidence of a gender gap or discrimination among male and female entrepreneurs at the micro, small and medium size enterprise (MSMEs) level.

In terms of our contribution to the literature, having reviewed a plethora of studies, it is pertinent to note that the most recent studies such as Hansen and Rand (2014) and Aterido et al. (2013), that use a Sub-Saharan African dataset, find that different approaches to measuring credit constraints give different results regarding the extent to which women are constrained in the formal credit markets, but they did not expressly consider the impact of credit on enterprise performance in Nigeria. Though in this study we followed one of the approaches used by Hansen and Rand in defining credit constraint, our sample is carefully chosen in order to minimize the risk of endogeneity and reverse causality as we explained in the methodology. Hansen and Rand's cross country study has the advantage of using a large sample in the estimations but was silent on how endogeneity issues were treated in the regression. If the risk of endogeneity is high, a large sample size may not give robust estimates. We also extended our analysis beyond manufacturing firms (which was the only sector analysed by Hansen and Rand) and included firms in different sectors covered in the survey. Again,

this gave us sample size advantage so as to be able to estimate the different variants of the model specifications as well as capturing small and medium enterprises better.

Furthermore, the literature on gender and credit access in Nigeria did not expressly address the issues of credit access and the performance of women-owned SMEs. For instance, Nwaru and Onuoha (2010), investigated the mean technical efficiency of the male/female farmers who have access to credit or do not, while Garba (2011) and Ubon and Arene (2013) study the risk attitude of female entrepreneurs and the determinants of formal and informal agro-based credits respectively. None of these studies investigated if there is a significant impact of credit on enterprise performance or not. Again, there is no robust approach adopted by these studies in defining access to credit, except that they asked an entrepreneur if he/she has access to credit or not. Furthermore, the dataset used by these studies is very small as data collection was just limited to one small area that may not represent the characteristics of the Nigerian lending market. Our work therefore differs from previous studies in Nigeria because we use a nationally representative dataset and make an innovative definition of credit constraint in order to reduce possible endogeneity issues. Also most of the earlier studies in Nigeria did not account for firm size nor controlled for informality in their discussion of credit and female entrepreneurship. Accounting for firm size would help to understand if the scale of the operation gives women entrepreneurs any advantage in the credit market. Informal credit has been used to measure the opportunity cost of capital (Hansen and Rand, 2014), or how the availability of alternative sources of funds could affect formal credit constraints. Thus, an important contribution of our study to the literature is to ascertain how credit constraint/access affects women's enterprises' performance in Nigeria. These are some of the critical gaps this research has addressed.

3. METHODOLOGY AND DATA

3.1. Defining credit constraint and sample of analysis

To properly identify the number of credit constrained firms, we adopt and modify the approach used by Hansen and Rand (2014), which is an extension of the works by Bigsten et al. (2003) and Bentzen et al. (2010). Hansen and Rand recognized the potential selection bias problem inherent in credit constraint studies since not all firms have external demand for credit

and they suggest that modifying the way credit constraint is defined could help to solve the selection bias problem. This approach is innovative and we slightly modified it as follows: i) we identified firms with demand for external finance, and ii) established the characteristics of credit constrained firms conditional on such credit demand. In this subsample, a firm is categorized as credit constrained if (1) it applied and was denied credit or (2) did not apply for credit due to reasons such as “application procedures too complex”, “collateral requirements unattainable”, or “possible loan size and maturity insufficient” (non-applicants) following the definition given by Baydas et al. (1992). From this definition we discard firms responding: “interest rates too high” or “did not believe it would be approved” and “insufficient profitability”, as reasons for not applying for credit. The reason for dropping these firms is that they do not appear to have a viable business plan and hence do not show the true entrepreneurial characteristic of risk taking. Also, we classified firms that financed their previous acquisition of fixed assets by borrowing from formal credit markets as credit unconstrained. Hence, an indicator variable which takes the value 1 if the firm is credit constrained and 0 otherwise was constructed based on the full rejection and half rejection of loan applications.

In defining whether a firm is credit constrained or not, our sample under study is restricted only to firms that already have a business and, in the current period, applied for credit or did not apply for the reasons listed above. We excluded those firms that already have an existing line of credit such as an overdraft, loans and financed their purchase of fixed assets with formal credit in the previous periods. By so doing, our final sample size reduces to 1,590 firms of which 1,330 firms are owned by male entrepreneurs and 260 of them owned by women entrepreneurs. Without these modifications, the total sample size would have been 2,994. We believe that the estimation subsample we have chosen helped to minimize the possible endogeneity and reverse causality of some of the explanatory variables. Endogeneity would have been very serious in our probit estimations because variables such as the firm’s age, manager’s years of experience and education of the owner would have had serious reverse causality with a firm’s access to credit if we had included firms that already have a line of credit in the sample. That being said, the estimations presented below are better used for the newly credit constrained/unconstrained firms in the current period, and not for those already receiving a credit at the time of the survey. For the latter, the results should be interpreted with some caution.

3.2. Model specifications

3.2.1. Impact of credit constraint on the performance of enterprises

In order to ascertain the impact of access to credit on the performance of micro, small and medium enterprises by gender we employed the propensity score matching (PSM) approach. We used this approach to be able to quantify the average effect related to credit constraint by matching credit constrained firms with similar firms that are credit unconstrained. The PSM approach is a widely applied method of impact evaluation because it helps to reduce the bias inherent in the non-observability of counterfactual outcomes. The propensity score is defined as the probability of treatment assignment conditional on observed baseline covariates (Rosenbaum and Rubin, 1983, 1985). The PSM is thus aimed at making participation similar to a random experiment and helps to avoid making assumptions about the distribution of the error terms and to avoid assuming additivity in the error terms.

To present the PSM method used in our analysis more formally, let the dummy Variable D_i equal to one if firm i is a treated firm (that is a credit constrained firm) and zero otherwise. Y_{i1} and Y_{i0} are the outcome variables or performance indicators (employment, output per worker, capital per worker, etc.) for the i th firm conditional on the presence and absence of treatment respectively. The treatment effect for the i th firm measures the difference between the relevant outcome indicator with treatment and the relevant outcome indicator without treatment. This is given by the following expression:

$$\Delta Y_i = E[Y_{i1} | D_i = 1] - E[Y_{i0} | D_i = 1]. \quad (1)$$

While the post-treatment outcome is observed, the counterfactual is not. In surveys such as the enterprise survey we are using, it is impossible to simultaneously observe someone in the two different states. As a result, the components $E[Y_{i1} | D_i = 1]$ and $E[Y_{i0} | D_i = 0]$ are observable outcomes, whereas $E[Y_{i1} | D_i = 0]$ and $E[Y_{i0} | D_i = 1]$ are non-observable outcomes. This is the missing data problem that makes impact evaluation difficult when random experimental data are not available. By filling in the missing data on the counterfactual, propensity score matching provides a potential solution to the evaluation problem. Hence, PSM is aimed at constructing a comparison group with non-treated units that are comparable to treated units on the basis of observable characteristics.

PSM rests upon a restrictive set of assumptions, namely conditional independence assumption (CIA) and existence of a comparison group. For PSM to mimic random experiments, as many covariates as possible could be included in its estimation so long as the balancing property is achieved and there is a sufficient common support region. The CIA assumption implies the absence of selection bias based on unobservable heterogeneity as Heckman and Robb (1985) pointed out. This assumption can be expressed as:

$$(Y_{i0}, Y_{i1}) \perp D_i | X_i$$

which states that for a given X , the mean of Y for non-participants corresponds to the mean that would have been observed for participants, had they not participated. That is,

$$E[Y_{i0} | D_i = 1, X_i] = E[Y_{i0} | D_i = 0, X_i]. \quad (2)$$

Following Rosenbaum and Rubin (1983), it is possible to condition participation on the propensity score denoted by $P(X)$ rather than on observable characteristics X . As a result, the propensity score which can be interpreted as the probability of treatment conditional on a vector of observable characteristics, reduces to one dimensional problem written as:

$$P(X_i) = \Pr(D_i = 1 | X_i).$$

Hence, the counterfactual can be estimated as:

$$E[Y_{i0} | D_i = 1, P(X_i)] = E[Y_{i0} | D_i = 0, P(X_i)]. \quad (3)$$

Thus, the average treatment effect for the i th firm can be measured by the following:

$$\Delta Y_i = E[Y_{i1} | D_i = 1, P(X_i)] - E[Y_{i0} | D_i = 0, P(X_i)] \quad (4)$$

Once we have estimated the propensity scores, we select matching estimators that describe how control units relate to treated units. Dehejia and Wahha (2002) argue that such matching on propensity score determines what weights are placed on control units when computing the treatment effects on the treated. Without having to show the metrics, we used the kernel and nearest neighbour matching in the estimation of the impact of credit constraint on firm performance.

Since matching to estimate average treatment effect on the treated is dependent on the CIA, such that the outcomes are not influenced by treatment assignment, our choice of covariates are based on theory and local context (Vathana et al., 2014; Caliendo and Kopeing, 2008), on the fact that information on treatment and controls come from the same set of questionnaires as well as participants and non-participants coming from the same local market (Heckman et al., 1997).

Hence the full specification of the model used to estimate the propensity score is given by the following equation which guarantees the satisfaction of the balancing property across all the subsamples under study. The variables are described in Table A6 in the appendix.

$$\begin{aligned} \text{constraint1_1} = & \beta_1 \text{female} + \beta_2 \text{age_dummy} + \beta_3 \text{experience} + \beta_4 \text{status} + \beta_5 \text{ownerCEO} + \\ & + \beta_6 \text{children} < 10 + \beta_7 \text{informal} + \beta_8 \text{finan_statement} + \beta_9 \text{educ_sec} + \beta_{10} \text{georegion} + \\ & + \beta_{11} \text{food} + \beta_{12} \text{garments_textile} + \beta_{13} \text{wood_furniture} + \beta_{14} \text{non_metallic} + \\ & + \beta_{15} \text{metals_othermanuf} + \beta_{16} \text{retail hotels} + \beta_{17} \text{construction_others} + \mu \end{aligned} \quad (5)$$

3.2.2. Sensitivity analysis for average treatment effects

We carried out sensitivity analysis to ascertain the extent to which our estimates of the treatment effects meet the CIA assumption. We note that the CIA assumption cannot be easily tested directly but inferences can be made about it based on recent developments in evaluation literature. According to Becker and Caliendo (2007, p. 1), “Matching has become a popular method to estimate average treatment effects. It is based on the conditional independence or unfounded assumption which states that the researcher should observe all variables simultaneously influencing the participation decision and outcome variables”. Hence, checking the sensitivity of the estimated results with respect to deviations from this identifying assumption has become fairly inevitable in any good study.

Following from Becker and Caliendo (2007), let the participation probability be given by $P_i = P(X_i, \mu_i) = P(D_i = 1 | X_i, \mu_i) = F(\beta X_i + \gamma \mu_i)$, where X_i are the observed characteristics for the i th firm, μ_i is the unobserved variable and γ is the effect on μ_i participation decision. Clearly, if the study is free of hidden bias, γ will be zero and the participation probability will solely be determined by X_i . However, if there is hidden bias, two firms with the same observed covariates X have differing chances

of receiving treatment. Let us assume we have a matched pair of firms i and j and further assume that F is the logistic distribution. The odds that firms receive treatment are then given by $\left(\frac{P_i}{1-P_i}\right)$ and $\left(\frac{P_j}{1-P_j}\right)$, and the odds ratio is given by:

$$\left(\frac{\frac{P_i}{1-P_i}}{\frac{P_j}{1-P_j}}\right) = \frac{P_i(1-P_j)}{P_j(1-P_i)} = \frac{\exp(\beta X_i + \gamma \mu_i)}{\exp(\beta X_j + \gamma \mu_j)}. \quad (6)$$

If both firms have identical observed covariates, as implied by the matching procedure, the X -vector cancels out implying that:

$$\frac{\exp(\beta X_i + \gamma \mu_i)}{\exp(\beta X_j + \gamma \mu_j)} = \exp(\gamma(\mu_i - \mu_j)). \quad (7)$$

Yet both firms differ in their odds of receiving treatment by a factor that involves the parameter γ and the difference in their unobserved covariates μ . So, if there are either no differences in unobserved variables ($\mu_i = \mu_j$) or if unobserved variables have no influence on the probability of participating ($\gamma = 0$), the odds ratio is one, implying the absence of hidden or unobserved selection bias. It is now the task of sensitivity analysis to evaluate how inference about the intervention is altered by changing the values of γ and $(\mu_i - \mu_j)$.

Rosenbaum (2002) identifies the following bounds on the odds-ratio that either of the two matched firms will receive treatment:

$$\frac{1}{e^\gamma} \leq \frac{p_i(1-p_j)}{p_j(1-p_i)} \leq e^\gamma. \quad (8)$$

Both matched individuals have the same probability of participating only if $e^\gamma = 1$. Hence Rosenbaum (2002) argues that if for example $e^\gamma = 2$, in this case firms that appear to be similar in terms of covariates could differ in their odds of receiving the treatment by as much as a factor of 2. Consequently, e^γ is a measure of the degree to which the matching

estimators are free of hidden bias. Increasing values of e^{γ} imply an increasing influence of unobserved characteristics in the treatment selection. This method uses matching estimates to calculate confidence intervals of the treatment effect for different values of e^{γ} . If the lowest e^{γ} producing a confidence interval that encompasses zero is small (that is less than 2), it is likely that such an unobserved characteristic exists and therefore that the estimated treatment effect is sensitive to unobservables. We calculated the Hodges–Lehmann point estimates as well as the 95% confidence intervals for the continuous outcomes using the `rbound` command in Stata, and the results are reported in table A5 in the appendix. We conducted the test only for the kernel estimator which we used largely to interpret the results of the propensity score in this study.

3.2.3. The data

The data for the proposed study were sourced from the World Bank Investment Climate Survey in Nigeria in 2010. The data collection consisted of a series of structured, face to face interviews with key senior managers/owners of a sample of 3,157 entities (including large enterprises which we did not include in our analysis because of no representation of women-owned firms at that level across 26 states (Adamawa, Akwa Ibom, Bayelsa, Benue, Borno, Delta, Ebonyi, Edo, Ekiti, Gombe, Imo, Jigawa, Katsina, Kebbi, Kogi, Kwara, Nasarawa, Niger, Ondo, Osun, Oyo, Plateau, Rivers, Taraba, Yobe, Zamfara) representing most sectors of activity and firms' size. The data is thus nationally representative and the survey was drawn from all geopolitical zones. The data covers large, medium and small size enterprises with about 422 firms owned by women entrepreneurs either as the sole owner or as the majority shareholder. The survey instrument has information explaining why firms did not apply for credit – one being that the firm has “no need for a loan, has sufficient capital”. The instrument also asked questions such as whether the establishment has an overdraft facility, the proportion of financing from different sources which include formal and informal sources, whether the establishment currently has a line of credit or loan from a financial institution, collateral requirements, whether the establishment applied for loans or lines of credit, and other firm characteristics. We included firms in different industries instead of limiting our sample to a few manufacturing firms as Hansen and Rand (2014) did in their study. The advantage of doing this is that most women entrepreneurs in micro/small establishments do not engage in manufacturing activities.

Therefore, concentrating only on the manufacturing firms may not allow us to have a clearer picture of the extent of credit constraint against women entrepreneurs generally. Second, we have more observations to work with by accounting for firms in different industries. The stratified sampling method was adopted in the data collection. Under stratified random sampling, unweighted estimates are biased unless sample sizes are proportional to the size of each stratum. The three weights integrated in the dataset to account for bias are the total weight per stratum in each state (*weight_reg* variable), the total weight per size in each state (*weight_size* variable) and the single weight per stratum in each state (*weight_est* variable). We chose the total weight per size in each state since this would normalize variations in sample in each state.

4. APPLICATIONS AND RESULTS

4.1. Descriptive statistics

Table A1 in the appendix shows the test of significance of difference in the mean of the variables between constrained and unconstrained firms. For most of the performance indicators, there is a statistically significant difference in means between firms that are credit constrained and those that are not. The negative differences show that the credit unconstrained firms have higher means. For example, average outputs per worker, capital per worker, purchase of fixed assets are significantly higher for credit unconstrained firms regardless of the size. Also, credit unconstrained firms at the micro enterprise level significantly use more informal sector loans. Surprisingly also, credit constrained firms on average keep more financial records than firms that are unconstrained.

Table A2 shows the actual summary statistics between constrained and unconstrained firms. The average of female-owned credit constrained firms is higher than unconstrained at medium enterprise level. The reverse is the case with micro enterprises where the average of female-owned credit unconstrained firms is higher than the constrained. Credit unconstrained firms on average employ more full time workers compared to the credit constrained firms. Both credit constrained and unconstrained firms have a similar pattern of household demographic structure shown by the number of children aged less than 10 years. However, the age dummy shows that entrepreneurs in the credit unconstrained firms are younger on average. Comparing the mean of the variables by gender as shown in Table A3, we

see that female-owned firms have a significantly higher average of level of education above secondary, have a higher average of being in sole proprietorship businesses and hence a higher average of being their own CEOs. Women entrepreneurs on average use more informal credit compared to men. On average firms in the garments and textile sector are mostly owned by women entrepreneurs.

4.2. Impact of credit on the performance of entrepreneurs: propensity score matching (PSM)

The estimation of the propensity scores that satisfy balancing properly is the first step in applying the PSM technique. We estimated propensity scores for the male-owned and female-owned firms and the combination of both. The propensity score estimates are reported in Table A4 in the appendix. All the estimated propensity scores satisfied the balancing property. The dependent variable takes the value 1 when the firm is credit constrained and 0 otherwise. The covariates we used in the estimation of PSM are the demographics of the firm's manager and owner, the years of experience of the manager, years of education of the manager, a variable indicating whether or not the firm is a sole proprietorship or not, a dummy variable indicating whether or not the owner is the CEO, a variable indicating whether or not the firm keeps proper financial statement records, indicator variables representing the geopolitical zones in Nigeria and indicator variables denoting the industry type.

The average treatment on the treated (ATT) effects for the weighted kernel matching estimator are reported in Table 1 together with the ATT effects from the nearest neighbour bias-adjusted estimator after conducting sensitivity analysis in the framework of Rosenbaum bounds reported in Table A5. The purpose of these results is to explain the impact of credit constraint on performance.

The propensity score results show that credit constraint decreases enterprise performance significantly in most of the performance indicators used. Overall, the propensity score matching methods show that firms that lack access to credit are in most cases less productive than firms that do not. This is also the case when the results are disaggregated by gender. Hence, entrepreneurs who face a credit constraint in the formal credit markets have a significantly lower capital per worker and acquisition of fixed assets compared to those that do not. Again, being credit constrained overall has a significant negative impact on investment in fixed assets for all firms, and a

significant negative impact on output per worker and capital per worker for female owned enterprises. This finding shows that access to formal credit has a strong positive impact on the growth and survival of enterprises, especially those owned by women. These results support the findings of Casey and O'Toole (2013), Buyinza and Bbaale (2013) and Radulescu (2010), who found similar results for the economies of Europe, the former Soviet Union and East Africa respectively.

The kernel and nearest neighbour estimates from our computations show that for enterprises that are credit constrained, investment in fixed assets for business expansion are respectively more than 30 and 27 percentage points lower than those who are not credit constrained. This is huge and again underlies the importance of credit in the growth of businesses and the growth of the economy. Again, among enterprises that are credit constrained, the estimated value of capital per worker is lower by about NGN3.3 million and NGN1.52 million respectively for women and men owned enterprises compared to those that are not (after taking the antilog of the ATT estimates reported for kernel estimates reported in Table 1) or is lower by about N4.43 million for female-owned firms using the nearest neighbour estimate. Again, investment in fixed assets is lower by about NGN1.98 million and NGN2.0 million for women and men enterprises respectively. Also, for firms that are credit constrained, output per worker is lower by 16.4 to 24 percent overall depending on the matching estimator. But this is much more pronounced for women-owned credit constrained firms, with output per worker lower by as high as 64 percent. For male-owned firms, the difference in output per worker between credit constrained and unconstrained firms is not statistically different from zero.

These numbers show the importance of access to credit in the overall performance of enterprises. Interestingly, it is in women-owned enterprises that we see the more significant impact of credit constraint. Hence access to credit is important for the survival of businesses in Nigeria.

Table A5 reports the results of the Rosenbaum procedure for the three different performance outcome indicators computed for the male-owned firms, female-owned firms and the combination of both. The treatment variable is credit constraint and the matching estimator used is kernel. The results shown in the table indicate that the robustness to hidden bias varies across the different outcomes and subsamples used in the estimation.

The results for output per worker for small and medium firms show that the lowest value of tau producing a 95% confidence interval encompassing zero is 1.8. This value implies that unobserved characteristics would have to

increase the odds ratio by about 80% before it would bias the estimated treatment effects. When considering the Hodges–Lehmann point estimates, the value of tau that encompasses zero reaches 2.0 or 2.2 for male-owned small/medium enterprises. But when the female-owned small/medium firms is considered, we see that the lowest value of tau producing a 95% confidence interval encompassing zero for output per worker is 1 and 1.4 for the Hodges–Lehmann point estimates. This shows that the treatment effect estimated for this variable for the subsample of female owned firms is sensitive to the influence of unobservable factors. The large differences between the kernel and nearest-neighbour estimators for female-owned firms (this is particularly the case for the output per worker and investment in fixed assets outcomes) is essentially due to the small number of observations in this group, especially in the untreated group. In such a case, the kernel matching estimator is considered less precise. On the contrary, the nearest-neighbour matching estimator as that estimated through the Stata `nnmatch` command is more precise as individual observations can be matched more than once.

For capital per worker, the lowest value of tau producing a 95% confidence interval encompassing zero is 1.4 for small and medium firms, implying that unobserved characteristics would increase the odds ratio by less than 40% to cause a bias in the estimated impact. The tau value is 1.2 for male-owned firms implying they would increase the odds ratio by less than 20% to cause a bias in the estimated impact and 1.6 (or less than 60%) for female-owned firms. The lowest Hodges–Lehmann point estimates of capital per worker that encompass zero for these subsample of firms occur respectively at 1.8, 1.6 and 2.4. These suggest that unobserved factors would have to increase the odds ratio respectively by at least 60% to cause a bias in the estimated impact. For female owned firms, we may conclude that the influence of unobservable for this variable is not serious. This is the reason why the estimated impacts on capital per worker using the kernel and nearest neighbour matching are similar in female-owned firms.

The Mantel–Haenszel (1959) bounds are reported for investment in fixed assets. The values of tau suggest that the estimated impact may be sensitive to the influence of unobservable factors except in the case of female-owned firms. In this case, the ATT results of the nearest neighbour estimate for fixed assets shows there is upward bias in the kernel estimates in the subsample of all firms and male-owned firms, and a downward bias in the kernel estimates for female-owned firms.

Table 1
Matching estimates of the impact of credit constraint on firm's performance

| Sample | No. of observations | | Kernel | | N/Neighb. bias adj. | |
|----------------------------|---------------------|---------|----------|--------|---------------------|--------|
| | Treatment | Control | ATT | t-stat | ATT | t-stat |
| Micro and medium firms | | | | | | |
| Output per worker | 928 | 373 | -0.24** | -1.978 | -0.164 | -1.52 |
| Capital per worker | 928 | 373 | -0.23* | -1.717 | -.1695 | -1.11 |
| Investment in fixed assets | 928 | 373 | -0.312** | -5.376 | -0.280** | -4.87 |
| Male-owned firms | | | | | | |
| Output per worker | 780 | 317 | -0.241** | -1.894 | -.1612 | -1.36 |
| Capital per worker | 780 | 317 | -0.183* | -1.429 | -.194 | -1.09 |
| Investment in fixed assets | 780 | 317 | -0.301** | -4.858 | -.273** | -4.36 |
| Female-owned firms | | | | | | |
| Output per worker | 132 | 55 | -0.242 | -0.916 | -.647** | -2.62 |
| Capital per worker | 132 | 55 | -0.518** | -2.184 | -.598** | -2.38 |
| Investment in fixed assets | 132 | 55 | -0.298** | -2.059 | -.484** | -3.90 |

Source: authors' computations

Notes: * indicates significance at 10%, ** indicates significance at 5% level of significance. Both the kernel and nearest-neighbour estimators were estimated by considering the sampling weights. The kernel estimator was estimated through the Stata pscore command by Beker and Ichino (2002) after modifying the original routine in order to take into account the sampling weights; the nearest-neighbour estimator was estimated through the Stata nnmatch command by Abadie et al. (2004).

CONCLUSIONS AND POLICY IMPLICATIONS

The main focus of this study is to ascertain the impact of access to formal credit on enterprise performance. From propensity score estimations, this study shows that access to formal credit matters and has a significant impact on enterprise performance indicators. Firms that are credit constrained have a significantly lower output per worker, capital per worker, employment of labour and investment in fixed assets for expansion compared to firms that are not credit constrained. This is more pronounced for women-owned enterprises after adjusting for bias in the estimations and controlling for sampling weights. More precisely, for entrepreneurs that are credit constrained, capital per worker and investment in fixed assets are significantly lower compared to those that are not credit constrained. Our kernel estimates show that for credit constrained firms, output per worker is lower by about 24%, capital per worker is lower by about 23% and investment per worker is lower by about 31.2%. The corresponding nearest

neighbour matching estimates for output per worker, capital per worker and investment per worker are respectively 16.4%, 17.0% and 28%. Although the result for capital per worker is not statistically significant after bias correction for the overall estimation, it is statistically significant in the subsample of female-owned firms. This suggests that one way to support the growth of enterprises in Nigeria is to make access to formal credit less stringent. Our results show that credit channel works better in improving the performance of small and medium enterprises in the country and consequently, monetary policy in Nigeria should include an easy access to formal credit for small and medium enterprises as one of its priorities.

Although it is difficult for government to direct formal financial institutions to offer credit to firms in a deregulated financial system, however direct government involvement by the use of intervention funds targeted to small and medium enterprises would make an impact. For example, the Nigerian government has released more than NGN400 billion as intervention fund through the Central Bank and the Bank of Industry. More recently the Governor of the Central Bank of Nigeria announced the release of a NGN220 billion SME intervention fund. If these funds target the entrepreneurs who are highly disadvantaged in the formal credit market, especially those in garments and textiles as well as in wood and furniture as we found in our probit estimations, they would go a long way in enhancing small and medium enterprise development in Nigeria.

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APPENDIX

Table A1

Test of significance of difference in means of the variables by treatment and control groups
(unconstrained and constrained)

| Variables | Micro/Medium (Constrained– Unconstrained) | | Micro/Small (Constrained– Unconstrained) | | Medium (Constrained– Unconstrained) | |
|-------------------|---|---------|--|---------|---|---------|
| | | | | | | |
| female | -0.00918 | (-0.41) | 0.00691 | (0.25) | -0.0375 | (-1.08) |
| experience | 0.287 | (0.61) | 0.285 | (0.53) | 0.212 | (0.22) |
| educ_sec | 0.0808*** | (3.21) | 0.110*** | (3.69) | -0.0113 | (-0.25) |
| status | -0.0499* | (-2.51) | -0.0285 | (-1.42) | -0.0827 | (-1.66) |
| age_dummy | 3.661*** | (4.92) | -0.351*** | (-5.71) | -0.0827 | (-0.90) |
| ownerCEO | 0.0201 | (1.07) | -0.00210 | (-0.10) | -0.109 | (-1.87) |
| employees | -4.060*** | (-6.72) | 0.396 | (1.32) | 8.525*** | (5.08) |
| children<10 | -0.0341 | (-1.16) | -0.0306 | (-0.89) | -0.0465 | (-0.81) |
| output_worker | -0.339*** | (-7.64) | -0.261*** | (-4.68) | -0.443*** | (-6.34) |
| capital_worker | -0.275*** | (-4.48) | -0.262*** | (-3.77) | -0.322* | (-2.41) |
| acquired land | -0.0220 | (-1.13) | -0.00141 | (-0.06) | -0.0604 | (-1.75) |
| purchased F/asset | -0.207*** | (-9.23) | -0.226*** | (-8.26) | -0.125*** | (-3.37) |
| informal | -0.0536** | (-2.59) | -0.0624* | (-2.48) | -0.0183 | (-0.53) |
| finan_statement | 0.185*** | (6.24) | 0.180*** | (5.10) | 0.133** | (3.17) |
| food | 0.0314* | (1.99) | 0.0215 | (1.41) | 0.0397 | (0.94) |
| garments_textile | -0.0630*** | (-4.62) | -0.0714*** | (-4.39) | -0.0379 | (-1.53) |
| wood_furniture | -0.0832*** | (-3.87) | -0.0790** | (-3.04) | -0.0853* | (-2.33) |
| non_metallic | 0.00563 | (0.35) | -0.00215 | (-0.11) | 0.0294 | (0.98) |
| metals_othermanuf | 0.0134 | (0.62) | -0.0178*** | (-0.70) | -0.102* | (2.44) |
| retail | 0.106*** | (4.61) | 0.144*** | (5.31) | 0.00623 | (0.15) |
| hotels | -0.00952 | (-0.36) | 0.0205 | (0.66) | -0.0935 | (-1.82) |
| Observations | 1302 | | 988 | | 314 | |

Source: authors' computations

Note: t statistics in parentheses * p < 0.05, ** p < 0.01, *** p < 0.001

Table A2

Summary statistics of the variables by treated and untreated, and firm size

| Variable | Micro and medium enterprises | | | Micro enterprises | | | Medium enterprises | | |
|--------------------|------------------------------|-------------|--------|-------------------|-------------|--------|--------------------|-------------|--------|
| | Unconstrained | Constrained | Total | Unconstrained | Constrained | Total | Unconstrained | Constrained | Total |
| female | 0.150 | 0.159 | 0.157 | 0.182 | 0.175 | 0.177 | 0.0673 | 0.105 | 0.0924 |
| experience | 12.06 | 11.75 | 11.83 | 11.94 | 11.65 | 11.73 | 12.30 | 12.09 | 12.16 |
| educ_sec | 0.842 | 0.761 | 0.784 | 0.851 | 0.741 | 0.771 | 0.817 | 0.829 | 0.825 |
| status | 0.842 | 0.894 | 0.880 | 0.892 | 0.921 | 0.913 | 0.721 | 0.804 | 0.776 |
| age_dummy | 0.287 | 0.396 | 0.365 | 0.160 | 0.316 | 0.273 | 0.615 | 0.671 | 0.653 |
| ownerCEO | 0.791 | 0.836 | 0.823 | 0.892 | 0.894 | 0.894 | 0.529 | 0.638 | 0.602 |
| employees | 17.11 | 13.48 | 14.52 | 9.581 | 9.199 | 9.303 | 36.65 | 28.13 | 30.95 |
| children<10 | 0.614 | 0.648 | 0.638 | 0.613 | 0.644 | 0.636 | 0.615 | 0.662 | 0.646 |
| output_worker | 13.81 | 13.45 | 13.55 | 13.69 | 13.41 | 13.49 | 14.11 | 13.56 | 13.74 |
| capital_worker | 10.31 | 10.02 | 10.10 | 10.29 | 10.02 | 10.10 | 10.43 | 9.988 | 10.12 |
| acquired land | 0.297 | 0.242 | 0.258 | 0.248 | 0.241 | 0.243 | 0.423 | 0.248 | 0.306 |
| purchased f/asset | 0.781 | 0.438 | 0.536 | 0.781 | 0.381 | 0.490 | 0.779 | 0.633 | 0.682 |
| informal | 0.0938 | 0.147 | 0.132 | 0.100 | 0.163 | 0.146 | 0.0769 | 0.0952 | 0.0892 |
| finan_statement | 0.727 | 0.541 | 0.594 | 0.643 | 0.463 | 0.512 | 0.942 | 0.810 | 0.854 |
| food | 0.0938 | 0.0624 | 0.0714 | 0.063 | 0.0417 | 0.0476 | 0.173 | 0.133 | 0.146 |
| garments_textile | 0.00804 | 0.0710 | 0.0530 | 0.0037 | 0.0751 | 0.0556 | 0.0192 | 0.0571 | 0.0446 |
| wood_furniture | 0.0858 | 0.169 | 0.145 | 0.100 | 0.179 | 0.158 | 0.0481 | 0.133 | 0.105 |
| non_metallic | 0.0777 | 0.0721 | 0.0737 | 0.0743 | 0.0765 | 0.0759 | 0.0865 | 0.0571 | 0.0669 |
| metals_othermanuf | 0.155 | 0.143 | 0.146 | 0.134 | 0.152 | 0.147 | 0.212 | 0.110 | 0.143 |
| retail | 0.249 | 0.143 | 0.174 | 0.286 | 0.142 | 0.181 | 0.154 | 0.148 | 0.150 |
| hotels | 0.241 | 0.251 | 0.248 | 0.264 | 0.243 | 0.249 | 0.183 | 0.276 | 0.245 |
| contruction_others | 0.0885 | 0.0893 | 0.891 | 0.263 | 0.287 | 0.281 | 0.125 | 0.0857 | 0.0987 |
| Observations | 1302 | | | 988 | | | 314 | | |

Source: authors' computations

Table A3

Test of significance of difference in means of the variables
by male and female and firm size

| Variable | Micro/Medium (Male–Female) | | Micro/Small (Male–Female) | | Medium (Male–Female) | |
|---------------------|-------------------------------|---------|------------------------------|---------|-------------------------|---------|
| | | | | | | |
| constraint1_1 | -0.0142 | (-0.41) | 0.00940 | (0.25) | -0.0990 | (-1.08) |
| experience | 1.469*** | (6.59) | 1.431** | (2.92) | 1.545 | (1.47) |
| educ_sec | -0.0459* | (-2.00) | -0.0414 | (-1.55) | -0.0990* | (-2.15) |
| status | -0.0714*** | (-3.50) | -0.0497** | (-2.57) | -0.0661 | (-1.17) |
| age_dummy | 0.189*** | (6.59) | 0.130*** | (4.21) | 0.235*** | (3.91) |
| ownerCEO | -0.103*** | (-4.34) | -0.0519* | (-2.35) | -0.147* | (-2.33) |
| employees | 2.841*** | (3.68) | 0.0774 | (0.30) | 1.070 | (0.56) |
| children<10 | 0.0659* | (2.40) | 0.0819** | (2.67) | 0.0176 | (0.29) |
| output_worker | 0.196*** | (3.44) | 0.164* | (2.50) | 0.170 | (1.48) |
| capital_worker | 0.159* | (2.17) | 0.0904 | (1.13) | 0.467** | (2.61) |
| acquiredland | 0.0162 | (0.65) | 0.0112 | (0.40) | 0.0270 | (0.48) |
| fixed_asset | 0.0438 | (1.51) | 0.00813 | (0.25) | 0.0582 | (0.96) |
| informal | -0.0338* | (-1.97) | -0.0341 | (-1.64) | -0.00270 | (-0.09) |
| finan_statement | 0.0612* | (2.19) | 0.00907 | (0.28) | 0.102* | (2.15) |
| food | 0.0174 | (1.17) | 0.0113 | (0.82) | -0.00642 | (-0.15) |
| garments_textile | -0.0772*** | (-5.52) | -0.0698*** | (-4.24) | -0.0968*** | (-3.55) |
| wood_furniture | 0.109*** | (5.31) | 0.153*** | (6.27) | -0.0128 | (-0.34) |
| non_metallic | 0.0236 | (1.53) | 0.0271 | (1.48) | 0.0276 | (0.94) |
| metals_othermanuf | 0.171*** | (7.83) | 0.196*** | (7.72) | 0.114** | (2.60) |
| retail | -0.0331 | (-1.55) | -0.0424 | (-1.72) | 0.0200 | (0.45) |
| hotels | -0.165*** | (-6.84) | -0.200*** | (-7.74) | -0.0840 | (-1.44) |
| construction_others | -0.0457** | (-2.93) | -0.0749*** | (-4.70) | 0.0386 | (0.95) |
| Observations | 2618 | | 1844 | | 774 | |

Source: authors' computations

Note: t statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A4. Propensity score estimates

| | Psmodel_all | Psmodel_male | Psmodel_female |
|-----------------------|-----------------------|-----------------------|-----------------------|
| female | 0.125 (0.268) | | |
| age_dummy | 0.482*** (0.000) | 0.529*** (0.000) | 0.540* (0.085) |
| experience | -0.0186*** (0.001) | -0.0170*** (0.008) | -0.0437*** (0.009) |
| status (soleowner=1) | 0.318*** (0.008) | 0.363*** (0.004) | -0.355 (0.460) |
| ownerCEO | 0.238* (0.030) | 0.269* (0.024) | 0.326 (0.334) |
| children<10 | 0.103 (0.226) | 0.0711 (0.441) | 0.107 (0.674) |
| informal | 0.317** (0.012) | 0.287** (0.033) | 0.445 (0.275) |
| finan_statement | -0.544*** (0.000) | -0.540*** (0.000) | -0.695*** (0.004) |
| educ_sec | -0.286*** (0.007) | -0.309*** (0.006) | -0.0137 (0.968) |
| South west | -0.152 (0.433) | | 0.123 (0.793) |
| North central | -0.398* (0.031) | -0.267* (0.067) | -0.113 (0.809) |
| North east | -0.677*** (0.000) | -0.493*** (0.001) | -0.422 (0.303) |
| North west | -0.285 (0.138) | -0.120 (0.451) | |
| South south | -0.0197 (0.916) | 0.181 (0.236) | 0.0558 (0.902) |
| food | -1.345*** (0.000) | -1.221*** (0.000) | -0.00170 (0.999) |
| wood_furniture | -0.645** (0.035) | -0.393 (0.221) | -0.384 (0.660) |
| non_metallic | -1.041*** (0.001) | -0.873*** (0.010) | 0.257 (0.766) |
| metals_othermanuf | -1.051*** (0.001) | -0.928*** (0.003) | |
| retail | -1.321*** (0.000) | -1.159*** (0.000) | -0.0779 (0.923) |
| hotels | -0.898*** (0.002) | -0.878*** (0.005) | 0.903 (0.260) |
| construction_others | -0.860*** (0.006) | -0.766** (0.022) | 0.731 (0.378) |
| georegion=South_east | | 0.183 (0.388) | 0.0142 (0.979) |
| Constant | 1.892*** (0.000) | 1.546*** (0.000) | 1.033 (0.305) |
| Observations | 1301 | 1097 | 188 |
| Pseudo R ² | 0.117 | 0.120 | 0.175 |
| chi ² | 182.0 | 158.1 | 40.09 |
| Correctly classified | 73.10% | 72.93% | 76.06% |

Source: authors' computations

Note: p-values in parentheses * p < 0.10, ** p < 0.05, *** p < 0.01

Table A5

Rosenbaum bounds sensitivity analysis (treatment group = credit constrained firms)

| Performance indicator | Tau | Hodges–Lehmann point estimates | | 95% confidence intervals | |
|-----------------------|-----|--------------------------------|----------|--------------------------|----------|
| | | Maximum | Minimum | Maximum | Minimum |
| All firms | | | | | |
| Output per worker | 1 | -.263882 | -.263882 | -.32519 | -.202962 |
| | 1.2 | -.33531 | -.192043 | -.39712 | -.130026 |
| | 1.4 | -.395769 | -.131268 | -.458295 | -.067606 |
| | 1.6 | -.447714 | -.077982 | -.511321 | -.01241 |
| | 1.8 | -.493619 | -.031012 | -.558457 | .036022 |
| | 2.0 | -.534505 | .011926 | -.599988 | .079153 |
| Capital per worker | 1 | -.226627 | -.226627 | -.310888 | -.141883 |
| | 1.2 | -.312294 | -.140493 | -.396559 | -.053774 |
| | 1.4 | -.383708 | -.066801 | -.46904 | .021534 |
| | 1.6 | -.446048 | -.003138 | -.531192 | .085774 |
| | 1.8 | -.498785 | .052291 | -.585332 | .143373 |
| Fixed assets* | 1 | 11.1859 | 11.1859 | 0 | 0 |
| | 1.2 | 12.6410 | 9.77423 | 0 | 0 |
| | 1.4 | 13.8969 | 8.60072 | 0 | 0 |
| | 1.6 | 15.0087 | 7.60018 | 0 | 1.5e-14 |
| | 1.8 | 16.0093 | 6.7288 | 0 | 8.6e-12 |
| | 2.0 | 16.9214 | 5.9574 | 0 | 1.3e-09 |
| Male-owned firms | | | | | |
| Output per worker | 1 | -.27689 | -.27689 | -.339695 | -.21228 |
| | 1.2 | -.345008 | -.207136 | -.40928 | -.14154 |
| | 1.4 | -.403332 | -.147772 | -.467735 | -.081212 |
| | 1.6 | -.452931 | -.096401 | -.517717 | -.027189 |
| | 1.8 | -.496612 | -.049975 | -.562985 | .019908 |
| | 2.0 | -.53514 | -.009282 | -.603333 | .063137 |
| | 2.2 | -.570661 | .027891 | -.639744 | .102239 |
| Capital per worker | 1 | -.146662 | -.146662 | -.240573 | -.053436 |
| | 1.2 | -.233653 | -.060317 | -.328793 | .035976 |
| | 1.4 | -.306368 | -.014161 | -.403741 | .110745 |
| | 1.6 | -.370105 | .07755 | -.468017 | .176544 |
| | 1.8 | -.426854 | .13357 | -.52423 | .234108 |
| Fixed assets* | 1 | 10.1349 | 10.1349 | 0 | 0 |
| | 1.2 | 11.4731 | 8.83761 | 0 | 0 |
| | 1.4 | 12.6274 | 7.75862 | 0 | 4.3e-15 |
| | 1.6 | 13.6491 | 6.83858 | 0 | 4.0e-12 |
| | 1.8 | 14.5685 | 6.03726 | 0 | 7.8e-10 |
| | 2.0 | 15.4064 | 5.32782 | 0 | 5.0e-08 |
| | 4.6 | 22.6686 | -.037513 | 0 | .514962 |

Table A5, cont.

| Female-owned firms | | | | | |
|--------------------|---------|----------|----------|----------|----------|
| Output per worker | 1 | -.162685 | -.162685 | -.384729 | .059098 |
| | 1.2 | -.254046 | -.069658 | -.477134 | .160914 |
| | 1.4 | -.342167 | .020304 | -.562951 | .254729 |
| | 1.6 | -.411431 | .088141 | -.641637 | .330489 |
| Capital per worker | 1 | -.482078 | -.482078 | -.740518 | -.243731 |
| | 1.2 | -.587147 | -.385453 | -.832316 | -.134796 |
| | 1.4 | -.672219 | -.311873 | -.920513 | -.022829 |
| | 1.6 | -.745611 | -.237155 | -1.00012 | .046223 |
| | 1.8 | -.796569 | -.170382 | -1.07221 | .106869 |
| | 2.0 | -.853122 | -.111184 | -1.14124 | .169391 |
| Fixed assets* | 2.4 | -.951695 | .005351 | -1.24009 | .269878 |
| | 1 | 4.41215 | 4.41215 | 5.1e-06 | 5.1e-06 |
| | 1.2 | 4.99238 | 3.86975 | 3.0e-07 | .000054 |
| | 1.4 | 5.48392 | 3.40977 | 2.1e-08 | .000325 |
| | 1.6 | 5.91905 | 3.01734 | 1.6e-09 | .001275 |
| | 3.2 | 8.35082 | 1.04832 | 0 | .147245 |
| 4.8 | 9.95088 | -.073072 | 0 | .529126 | |

Source: authors' computations

* Mantel-Haenszel (1959) bounds are reported for investment in fixed assets using mhbound command in Stata. The estimates are assumed to encompass zero at tau value of 3.2 using the 95% confidence interval since zero is lying on the critical value.

Table A6

Definitions of variables of the models we estimated

| Variable | Definition and motivation |
|-----------------|---|
| constraint1_1 | This is the credit constraint variable which takes the value 1 if the firm is credit constrained and 0, otherwise. |
| experience | Years of experience of the firm manager (CEO): firms with experienced managers are more likely to understand the procedures for applying and securing a loan from a formal institution than firms with less experienced managers. As a result, such firms are less likely to be credit constrained. |
| educ_sec | Education level of the owner (0=no education, 1=primary, 2=secondary, 3=technical, and 4=tertiary education): We expect that managers with a secondary education and above better understand the strategies and techniques for securing loans from formal credit institutions and also when and where to apply compared to less educated owners or managers. |
| finan_statement | Statement of financial condition: Firms that have good financial statements enjoy some form of goodwill that enables them to have access to finance relatively more easily than firms that have poor financial statements. Consequently, such firms are less likely to be credit constrained. We also expect that formal credit institutions will be more inclined to grant loans and credit facilities to firms with good financial positions as reflected in their financial statement. |

Table A6, cont.

| | |
|----------------------------|--|
| status | This is an indicator variable showing the type of business ownership, 1 if the firm is sole proprietorship and 0 otherwise. Financial firms are not better disposed to lend to single-owner firms than they are to partnerships and incorporated firms. They believe that in a one man business the death of the owner may change the structure of the firm or even bring it to an end, which could affect the chances of such enterprises to obtain credit. |
| female | 1 if the sole owner or majority shareholder is female and 0 if male. |
| ownerCEO | 1 if the owner is the chief executive officer and 0 otherwise: This is the case with many firms in the dataset. The owner or majority shareholder is not different from the chief executive officer. When the owner is the chief executive officer, risk-taking is minimal and the demand for external finance will be low. |
| children<10 | The owner has children aged less than 10. As a control, children under 10 years of age take account of the demographic structure of the household of the firm owner. |
| age_dummy | Age category of the owner. The effect of age on the chances of a firm being credit constrained could be negative or positive. For example, when formal lenders become apprehensive of aging business owners, it can increase the probability of being credit constrained. Also, we introduce this to account for the effect of demographics on the probability of being credit constrained. |
| informal | 1 if the firm has used informal credit and 0 otherwise. Firms that have access to informal credit are less likely to take the pains and troubles of applying for formal loans or credit. This is usually common with small or micro enterprises. |
| industry | Group dummy for the type of industry (food, garments/textile, wood/furniture, retail, construction, etc): we hypothesize that the type of industry the firm is engaged in may affect the probability of being credit constrained. Formal lenders prefer industries with regular cash inflows or turnover to industries with irregular inflows. |
| georegion | North_central=1, North_east=2, North_west=3, South_east=4, South_south=5, South_west=0. The zonal dummy accounts for the regional distribution of the firms and their owners across the nation. Here we use South_west as the base category for the zonal dummy. |
| Outcome Indicators | |
| output per worker | Output per worker is measured as the logarithm of total output of the firm in monetary terms divided by the total number of workers employed by the firm over that period. We took the logarithm of the result to rescale the data appropriately. |
| capital per worker | Capital per worker is the logarithm of total monetary value of investment of the firm in fixed assets divided by the total number of workers employed by the firm. |
| investment in fixed assets | This is an indicator variable which takes the value 1 if the firm invested in fixed assets in the current period, and 0 otherwise. |

Source: authors' elaboration

Table A7
Summary of related literature

| Authors | Objective of the research | Methodology | Country | Findings |
|--------------------------|---|-------------------------------|---|---|
| | Studies that found significant impact of access to credit on enterprise performance | | | |
| Nikaido et al. (2015) | The paper investigates enterprise level factors affecting access to formal credit for small enterprises in India. | Probit sample selection model | India | The study shows the relevance of formal credit in enhancing firms' performance. It further indicates that owners' education level, enterprise size, being registered under an agency and being involved in diversified activities are positively associated with access to formal credit. However, the ownership of land that can be used as collateral is negatively associated with the likelihood of receiving formal credit. This may be due to an obsolete land administration system resulting in high transaction costs of land as collateral. These results provide some insights into the factors to improve credit constraints for small enterprises in India. |
| Casey and O'Toole (2013) | The study examines whether bank loans constrained SMEs are more likely to avail themselves of alternative forms of external finance and the impact of access to alternate external finance on business fixed investment and innovation. | Probit model | All Eurozone economies within the crisis period | The study finds that SMEs that are bank-lending constrained are significantly more likely to avail themselves of alternative forms of external finance, controlling for firm-level and country-level characteristics. The results also show that access to alternative finance substantially reduces the likelihood of business fixed investment. This effect is not evident for business innovation. |
| Radulescu (2010) | The focus of the paper is on access to credit and credit constraints and their impact on 28 Eastern European (CEE) and former Soviet Union (CIS) countries. | Multinomial treatment model | 28 Eastern European (CEE) and former Soviet Union (CIS) countries | The results show that access to credit matters for firms' performance and that the highest percentage of credit constrained firms is found to be higher in the CIS (25%) than in the CEE (10%). Again, these constraints have an effect on firms' investment in fixed assets, employment growth, spending on research and development, and the introduction of new products. |
| Brahn (2009) | The paper examines access to credit, firm characteristics and performance of female-owned firms in Latin America. | Multidimensional analysis | Latin America | The study supports that access to credit enhances firms' performance. The results also show no evidence that female-owned firms have less access to external finance than male-owned firms. Again, female firm owners are no more likely to perceive a host of institutional and market related factors to be obstacles to firms' operation and growth than male-owned firms. The only significant difference in perceived obstacles is that female firm owners are up to 50 percent more likely than male firms owners to report that having to care for children and household obligations poses an obstacle to firms' operation and growth. This paper is related to Sabarwal and Terrell (2009) who study the performance of female-owned firms in Latin America. |

Table A7, cont.

| | | | | |
|--|--|--|---|---|
| Canepa and Stoneman (2008) | The study explores the role of access to financial factors on innovation in the UK | Cash flow model | United Kingdom | The result shows that access to financial factors do impact upon innovative activity and that impact is more severe in higher tech sectors and for smaller enterprises. |
| Boissay and Gropp (2007) | The study investigates whether and how access to trade credit is used to relax financial constraints. | Tobit | France | The study shows that credit constrained firms pass more than one fourth of the liquidity shocks they face on to their suppliers down the trade credit chain. They also find that firms provide liquidity insurance to each other and that this mechanism is able to alleviate the consequences of credit constraints. |
| Aterido, Hallward-Driemeier and Pages (2007) | The paper analyzes the impact of various access/ constraints to finance, corruption, regulation and infrastructure across firm types and firm sizes. | OLS regression | Firm level data based on 70,000 enterprises in 107 countries. | The study finds that low access to finance and ineffective business regulations reduce the growth of firms particularly micro and small firms. |
| Rotich et al. (2015) | This study analyzes the impact of access to micro finance on the performance of micro small and medium-sized enterprises (MSMEs) in Kiambu, Kenya. | Multiple regression analysis | Kenya | The study found access to savings, managerial training and loan grace period to be statistically significant in determining the performance of MSMEs. Thus, increasing provision levels of access to credit and micro finance will result in the increased performance of micro enterprises. |
| Opoku-Mensah and Agbekpormu (2015) | The study analyzes the factors that influence access to credit by agribusiness operators in the Kumasi metropolis of the Ashanti region of Ghana. | The logit model | Ghana | The empirical results supports the usefulness of credit in firm performance and also revealed that the factors that significantly influenced credit accessibility for respondents in the study area were the borrowing experience, credit management skills, possession of collateral security, extra income earned by operators, firm size, and membership of business organization. The major constraining factors faced by respondents in their credit application from the formal sector include inadequate loan amount, high interest rate, and unfavourable loan terms. |
| Ocholah et al. (2013) | The study was designed to determine how access to micro financing impacts the profitability, productivity, performance, growth and expansion of women-owned enterprises in Kisumu City, Kenya. | Descriptive statistics | Kenya | The results show that access to micro financing in sufficient quantities would have a greater effect on profitability, productivity and growth and the expansion of women-owned enterprises. |
| Buyinza and Bbaale (2013) | The study examines the factors influencing manufacturing firms' access to credit and the effect of credit constraints on firm performance in the East African Community (EAC). | Simple probit, simple OLS, Tobit, and a two-step probit models | East African Community Bank (2006) enterprise survey for five EAC countries | The study shows that having access to credit and a long loan duration increase firms' performance, while an increase in the annual interest rate reduces firms' productivity. |

| | | | | |
|-------------------------------------|--|--|--|--|
| Machirori (2012) | The study estimates the impact of networking on access to finance and on performance of SMEs in South Africa. | Univariate and bivariate analysis | Buffalo City municipality in the Eastern Cape Province of South Africa | The study reveals a significant positive relationship between networking and access to debt finance and performance of SMEs. |
| Ojah, Tendai, and Sheshangai (2010) | The study investigates how access to finance and environments affect investments by firms in East Africa. | Multiple regression | Firms in East Africa | The study finds that access to external finance, internal finance, property rights, firm size, and an export-orientation, are important determinants of the investment decisions. |
| Bigsten and Soderbom (2005) | The study, based on review of the literature, investigates the impact of access to finance and business environment on firms' performance in Africa. | Qualitative analysis based on enterprise survey and firm level data. | Africa | The results show that business environment is the leading constraint after financing and it is the prime suspect as to why firms' performance in Africa is poor. It also leads to high indirect costs. |
| Ubun and Arene (2013) | The study examines how accessibility to credit impacts the performance of small agro-based enterprises in the Niger delta region of Nigeria. | Logit model | Agro-based enterprises in the Niger delta region of Nigeria | The study reveals that the factors that influence access to formal credit are education, age, enterprise size and collateral, while the factors that significantly influence informal credit access for small scale agro-based enterprises are gender, age and social capital, and credit impacts positively on firms' performance. |
| Li, Lu and Yang (2013) | The paper investigates the impact of access to trade credit on firms' performance. | OLS and instrumental variables | China | The results of the OLS estimation show that access to trade credit is significantly and positively correlated with firms' performance. However, after including instrumental variables to tackle potential endogeneity issues, trade credit no longer has any impact on firms' performance. Thus, the study suggests that trade credit plays a limited role in firms' performance. |
| White, Maru and Boit (2015) | The study examines the relationship between firms' access to financial resources and the performance of women-owned and men-owned SMEs. | Descriptive statistics and inferential statistics (ANOVA) | Kenya | The study reveals that access to finance has no significant correlation with firms' performance, with all predictors accounting for 66.5% variation of the performance of SMEs. |
| Nwaru and Onuoha (2010) | The study assesses the impact of credit use on the technical efficiency of small food crop farmers in Imo State of Nigeria. | Maximum likelihood and ordinary least squares | Nigeria | The results show that the mean technical efficiency of the farmers producing without credit was significantly higher than that of the farmers producing with credit, indicating that credit may not have been used properly. |
| Atandi and Wabwoba (2013) | The purpose of the study is to determine the impact of credit available to MSMEs on business performance in Kitale town, Kenya. | Descriptive method | Kenya | The results show that that access to credit or credit availability does not guarantee a bigger market share or better performance by MSMEs. The effect of credit available to MSMEs on business performance by considering stock levels held also revealed that little money was allocated to purchase additional stock. Again, on establishing the impact of credit available to MSMEs by considering the additional number of employees, it was found that credit access to MSMEs does not necessarily lead to good performance. |

Table A7, cont.

| | | Studies that found evidence on gender gap or discrimination in access to credit | | |
|---------------------------------------|---|---|---|--|
| Naranchimeg and Bernasek (2013) | The paper estimates a model of credit rationing by gender of the business owner. | Probability and credit rationing | USA | The study finds higher loan denial rates and lower loan application rates among women compared with men. Testing the robustness of the results, the study reveals that women seem to be rationing themselves in the credit market rather than being discriminated against by banks. |
| Beck et al. (2011) | The paper examines the effects of group identity in access to credit market. | Difference-in-differences estimation | Albania | The results show that borrowers pay on average 28 basis points higher interest rates when paired with a loan officer of the other sex. The results indicate the presence of a taste-based rather than a statistical bias, as borrowers' likelihood of going into arrears is independent of the loan officer's gender. Ending up with an opposite-sex loan officer also affects demand for credit, with borrowers being 10.6 percent less likely to return for a second loan. The bias is more pronounced when the social distance, proxied by the difference in age between the loan officer and the borrower, increases and when financial market competition declines. |
| Muravyev, Talavera and Schafer (2009) | The study provides an insight into the financial constraints faced by females in self-employment and entrepreneurship. | OLS regression and instrumental variables, binary response model | Cross country | The study reveals that female-managed firms are about 5% less likely to receive a loan when compared to male-managed counterparts. |
| Klapper and Parker (2011) | The paper investigates the relationship between gender and entrepreneurship. | Qualitative review | Cross country | They find that enterprises owned by men on the one hand and women on the other, are generally concentrated in different sectors, male entrepreneurs are found in more capital intensive manufacturing industries, while women entrepreneurs are better represented in labour intensive sectors such as trade and services. |
| Annim and Arun (2013) | The paper examines the gender gaps in the use of more advanced financial services such as investment and insurance. | Ordered logit models | Ghana and South Africa | The study finds that females in South Africa are more likely to use general financial and investment products than in Ghana. The results also reveal that in Ghana, a substantial part of the gender differentials in the use of financial services can be attributed to unobserved characteristics, mostly related to attitude and perceptions that inhibit women's use of financial services. |
| Camara et al. (2014) | The paper investigates the existence of gender-based discrimination and the extent to which it may translate into lower performance of female-owned firms in Senegal. | Endogenous switching regression model | A survey of 606 firms in four main regions in Senegal | The results show that female entrepreneurs are not more or less credit constrained than their male counterparts, and to the extent that they do benefit from credit, they tend to enjoy similar returns from the funds. |
| Aterido et al. (2011) | This paper assesses whether there is a gender gap in the use of financial services by businesses and individuals in Sub-Saharan Africa. | Pooled regression, logit and probit models | Nine Sub-Saharan African countries | The study found no evidence of gender discrimination or lower inherent demand for financial services by enterprises with female ownership participation or by female individuals when the key characteristics of the enterprises or individuals are taken into account. |

Source: authors' elaboration