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Is there discrimination against women entrepreneurs in formal credit markets in Nigeria?

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policy analysis on growth and employment

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Abstract

This research investigates whether women entrepreneurs in small and medium-sized enterprise (SMEs) in Nigeria are marginalised in formal credit markets compared to their male counterparts. The study also investigates the impact of credit access on the performance of enterprises. The study uses Nigerian Enterprise Surveys data from 2010 to construct a direct measure of credit constraints in order to address the objectives. A probit credit constraint model was estimated, and nonlinear decomposition methods as well as propensity score matching methods were employed in the analyses. Our results did not show significant discrimination against women in formal credit markets in Nigeria. The results reveal that firms that are not credit constrained in the formal credit market perform measurably better in terms of output, output per worker and the decision to invest/expand, compared to firms that are constrained. Our results also show that access to formal credit by small and medium enterprises in Nigeria is still very low. The policy implications, among others, are that government and monetary authorities should support credit expansion policies for medium and small enterprises by creating an enabling environment for financial intermediation in Nigeria. Also, intervention funds targeted specifically at medium and micro enterprises would help to ease credit constraints.

JEL: O16, O17

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I. Introduction

1.1 Context of the study

The role of women entrepreneurs in national development has become widely recognized in many parts of the world, not only in developing countries but also in the developed world. The rate at which women now contribute to economic development through their participation in small and medium-scale enterprises is quite unprecedented despite continued barriers to the full optimization of their economic potential. For example, one of the recent reports published by the Global Partnership for Financial Inclusion (GPFI, 2011, p. 12), highlights that in developed countries, women are starting businesses at a faster rate than men, and are making significant contributions to job creation and economic growth. According to the report, the recorded number of women-owned firms grew at more than twice the rate of all other firms owned by men (23 percent and 9 percent respectively per annum) in the United States for nearly three decades. Also in Canada, the report shows that women own about 47 percent of small enterprises and accounted for about 70 percent of new business start-ups in 2004.

In developing economies, women are currently participating actively in economic activities through ownership of business ventures, and through this means have contributed in a noteworthy manner to economic growth and poverty reduction. For example, a survey of 1228 female business owners in the Middle East and North Africa (MENA) region found that women are running well-established businesses that are generating revenue well over $100,000. This is comparable to the revenue generated by women-owned firms in the United States. In Indonesia, 2007 data showed that the number of women-owned businesses rose by 8 percent per annum, while the number of men-owned businesses shrank by 0.3 per cent per annum. In 2008, women-owned businesses grew on an annual basis by 2.3 percent in Thailand, while the male counterparts grew only by 0.3 percent; in Malaysia, 2008 data show that women-owned enterprises grew by about 10 percent compared to about 7-percent growth of men-owned enterprises (GPFI, 2011, p. 13).

In the last two decades, the Nigerian economy has seen increasing participation of female entrepreneurs operating at the small and medium enterprise (SME) level. For example, a survey carried out by 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 (of which 17,261,753 micro, 21,264 small and 1,654 medium). The total number of persons employed by the micro, small and medium enterprises (MSME) sector as of December, 2010 stood at 32,414,884. Of this number, the women entrepreneurs account for 42.1 percent in the ownership structure of microenterprises, and 13.6 percent of the ownership structure in small and medium enterprises. The SMEDAN survey shows that the contribution of MSMEs to national nominal gross domestic product stood at 46.5 percent during the period under review. One of the recommendations of

the Survey Report is that access to finance is one of the priority areas of assistance to MSMEs in Nigeria.

In Nigeria, discrimination experienced by women in economic activities is very visible in some sectors. For example, the proportion of women in the formal sector is very minimal, particularly in industry and civil services. Available data from the National Bureau of Statistics (NBS) indicate that in the federal civil service which is the highest employer of labour in formal employment, women are mostly found in junior positions. According to statistics, 78 percent of women are mostly engaged in the informal sector, mostly in farming and petty trade. Apart from their unequal representation in formal employment, most of their contributions to economic activities are not paid for. In the case of Nigeria, women's unpaid labour is twice that of men, and its economic value is a sizeable proportion of the nation's gross national product. Furthermore, women are denied legal right to own property or inherit land, in particular in the Northern part of the country due to cultural reasons. The Nigerian household and living standards survey data highlight that in the Northern part of the country, women own only 4% of land and just over 10% of land ownership in the Southern part. It was only recently that the court ruled in favour of women to inherit property in few states especially in the South-east geopolitical region of the country. Before now women had no right to partake in sharing their father's wealth. Women also have limited access to agricultural inputs. It is also argued that women tend to be disadvantaged, because compared to men, they do not have access to obtaining credit facilities and so are rarely engaged in the production and marketing of lucrative cash crops, such as cocoa, which tends to be a male preserve.

Therefore, access to finance is often cited as one of the major factors impeding the growth of women-owned businesses in developing countries. Hence, one of the critical questions in the existing literature is the issue of whether, and the extent to which, women entrepreneurs experience discrimination in the formal credit market especially in the developing world. Credit is an important instrument for improving the welfare of the poor and for the expansion of business frontiers (Okurut et al., 2004). Access to credit may also limit the scope of businesses that women will be able to engage in. Therefore, the importance of easy access to credit by women entrepreneurs even at the level of small and medium-sized enterprises (SME) in boosting their business fortunes and in poverty reduction has been highlighted.

The Nigerian credit market can be broadly categorized into the 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 microfinance 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, rotating savings and credit associations, 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, some problems still plague the sector. The key ones include location of 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. Thus, access to the credit market in Nigeria has really been an issue of serious concern. Several other constraints identified to exist in the market include: poor credit penetration, issues of collateral, complex application procedures and asymmetric information, among others (NBS, 2011).

This study therefore contributes to the ongoing empirical debate on access to credit in three ways: First, the study investigates if women entrepreneurs experience discrimination in the formal credit markets in Nigeria. Second, the study determines the extent to which enterprise characteristics explain the gender credit gap in Nigeria, and third, the study ascertains the impact of credit on enterprise performance. The rest of the paper is structured as follows: The next section provides an overview of the literature and section 3 provides the methodological framework. The result is presented and analysed in section 4. Policy implications and conclusions are presented in section 5.

II. Literature Overview

There is large volume of literature on various forms of gender discrimination. However, what we have learned from existing literature in access to credit is that there is no clear conclusion on discrimination of women in the formal credit markets. Strands of literature have emerged on the subject with each strand taking a particular position on gender discrimination in access to credit. For instance, studies like Riding and Swift (1990), Kondo (2003), De Mel et al. (2009) and Bardasi et al. (2011) find no evidence of discrimination against women entrepreneurs in credit markets. On the other hand, the empirical works of Bellucci et al. (2010), Malapit (2010), Fletscher and Kenny (2011), Hansen and Rand (2014) and Hashimzade and Rodionova (2013) find evidence of gender credit constraint and discrimination against women in access to formal credits. Thus, the mixed results in the literature suggest that the argument of whether or not there is discrimination against women entrepreneurs in formal credit markets, especially in developing countries where discrimination against women is huge, still remains an empirical issue.

Similarly, empirical literature on the impact of access to credit on the performance SMEs have produced mixed results. For example, authors like Winker (1999) and Ojah et al. (2010) argue that 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 firm performance in the East African Community (EAC) using the World Bank (2006) enterprise survey for 5 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 both increase firm performance, while a higher annual interest rate reduces firm productivity.

Leroy (2012) investigates the impact of networking on access to finance and 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 performance of SMEs. Similarly, Mach and Wolken (2012) examines 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) examine the empirical relationship between credit terms, credit accessibility and the performance of agricultural cooperatives in Rwanda. The result shows a positive and significant relationship between credit terms, credit accessibility and the performance of agricultural cooperatives. This is in agreement with the studies of Kaplan (2006) who argue that when credit terms are favourable they encourage borrowing and therefore the expansion of the capital base leading to increased business activity.

More empirical support of a link between credit access and SME performance comes from Boissay and Gropp (2007), who argue that firms confronted with a shortage of financing try to overcome this situation by passing on one-fourth of the shock to their suppliers, in effect taking more trade credit. Other authors such as Canepa and Stoneman (2008) equally emphasize that limited access to external finance negatively affects small firms' decision to invest in fixed capital and research and development, which subsequently limit their growth, innovativeness and performance.

Aghion et al. (2007) further documents that access to external financing promotes new entry of small firms to take advantage of growth opportunities in the expanding sectors and helps smaller firms to compete with larger firms on a more level playing field in business. Other studies that find positive relationships between credit access and SME performance include Angelini, Di Salvo and Ferri (1998), Bougheas et al. (2009), among others.

On the other hand, some studies have found a negative or weak link between credit access and SME performance. For example, Kang and Stulz's (2000) results for a sample of Japanese SMEs indicate better performance for SMEs not financed by banks compared to firms with high shares of bank debt. Li, Lu and Yang (2013) examine the impact of credit on SME performance in China. Ordinary least squares estimations show that credit access is positively correlated with firm performance. However, after they use the instrumental variable approach to tackle potential

endogeneity issues, the effect of credit access is no longer statistically significant. Similarly, Vu and Nguyen (2013) show that show that SMEs whose credit relationship(s) with banks are on a very short-term basis perform poorly compared to those with longer-term loans, in the case of 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.

In terms of our contribution in this study, it is pertinent to note that most recent studies such as Hansen and Rand (2014) that use a Sub-Saharan African dataset find that different approaches to measuring credit constraint give different results on the extent to which women experience discrimination in the formal credit market. 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, large sample size may not give robust estimates. We also extended our analysis beyond manufacturing firms and included firms in different sectors captured in the survey. Among other things, the larger resulting sample size made it easier to estimate variants of model specifications and to better capture SME activity.

Also, in their methodology, Hansen and Rand used a generalised Oaxaca–Blinder decomposition and traditional logit model in their analysis but we adopted Fairlie (1999 and 2003), which is more appropriate for decomposing binary outcomes. The Oaxaca (1973) decomposition technique cannot be used directly for binary outcomes, and so for example is not used for coefficients of probit or logit models. The Fairlie (1999 and 2003) decomposition is more suitable for a nonlinear equation. Hansen and Rand (2014) focused on mainly on manufacturing firms but our study included entrepreneurs in other sectors like food, hotels and retail services. Our dataset is more country-specific, richer and more current. While Hansen and Rand (2014) used data from 2006-2007 survey, ours is a 2010 enterprise survey.

Furthermore, gender and credit access literature in Nigeria did not expressly address the issues of credit discrimination experienced by women at the SME level. For instance, Nwaru and Onuoha (2010) investigated the mean technical efficiency of the male/female farmers who have access to credit or not, while Garba (2011) study the risk attitude of female entrepreneurs. None of these studies investigated whether there is gender discrimination in formal credit market in Nigeria or not and there is no robust approach adopted by these studies in defining access to credit except that they asked an entrepreneur whether he/she has access to credit. Furthermore, the dataset used by these studies is very small as data collection was just limited to one small area that may not be representative of 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 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 discrimination against women entrepreneurs. Accounting for firm size would help to understand whether the scale of operation gives women entrepreneurs any advantage in the credit market. Informal credit has been used to measure opportunity cost of capital (Hansen and Rand, 2014) or how availability of alternative sources of funds could affect formal credit constraint. Another important contribution of our study to the literature is to ascertain how credit constraint affects enterprises owned by women perform in Nigeria. These are some of the critical gaps this research is designed to address.

III. Methodology and Data

3.1 Theoretical framework

Analysis of discrimination in credit markets has been a complex and subtle issue in micro econometric literature. Baydas et al.'s (1992) pioneering work on discrimination in credit markets takes the view that analysis of internal self-selection and external credit rationing would help to determine if the distribution of borrowers and the amount borrowed differs among different categories of loan applicants. They consider simple discrimination to occur if one class of customers obtains more or less loans than another. They refer to internal self-selection as when a group of potential loan applicants self-select themselves and decide to not even apply for a loan. One reason is true self-selection that occurs when potential applicants do not apply for formal credits because they do not have a true demand for external finance although some of them may report a "need" for credit when asked. The second reason, according to them, may be due to induced self-selection where potential applicants do not apply for loans because they perceive they will be rejected.

Baydas et al. (1992) put forward that self-selection based on the belief that loan applications will be rejected may reflect a correct assessment because these applicants do not possess the attributes (income, collateral, etc.) required by lenders. These attributes are among those which reflect barriers to access to formal credit markets for some potential applicants. Alternatively, these potential applicants may have incorrectly concluded that their applications would have been rejected when in fact they would have been approved. They argue that while internal self-selection cannot be easily quantified, it is more likely to explain the behaviour of many women, small farmers, micro entrepreneurs and poor people who rely heavily on the informal sector for their financial services. Therefore, our definition of credit constraint is guided by this framework.

3.1.1 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 recognised the potential selection bias

problem inherent in credit constraint studies since not all firms have external demand for credit and they suggest that selection bias could be overcome by modifying the definition of credit constraint. This approach is innovative and we slightly modified it as follows: we identified (i) firms with demand for external finance, and (ii) conditional on such credit demand established the characteristics of credit constrained firms. In this subsample, a firm is categorised 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 remove 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 therefore cannot really be defined as entrepreneurs. Also, we classified as credit unconstrained those firms having financed their previous acquisition of fixed assets by borrowing from formal credit markets. This process yields an indicator variable which takes a value of 1 if the firm is credit constrained and 0 otherwise, constructed based on full rejection and half rejection of loan applications.

In defining whether a firm is credit constrained or not, our sample of analysis is restricted to only 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 existing lines of credit such as overdraft and loans, and those that financed their purchase of fixed assets with formal credit in the previous periods. In so doing, our final sample size is reduced to 1590 firms of which 1330 firms are owned by entrepreneurs who are men and 260 owned by women. Without these modifications, the total sample size would have been 2,994 based on the dataset. 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 firm 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 line of credit in the sample. That having been said, the estimations presented below are better to be used for the newly (i.e. in the current period) credit constrained/unconstrained firms, and not for those already receiving 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 Ascertaining gender credit constraint

In order to ascertain whether women are more credit constrained than men in the formal credit markets, we specified the following probit model of credit constraint, which we estimated

by different firm sizes. The variable *$\beta_6$female* which takes a value of 1 if the entrepreneur is a female and 0 otherwise is the variable of interest in our probit estimation.

$$\begin{aligned}\text{Contraint} &= \beta_0 + \beta_1\text{experience} + \beta_2\text{educ\_sec} + \beta_3\text{finan\_statement} + \beta_4\text{children} < 10 \\ &+ \beta_5\text{status} + \beta_6\text{female} + \beta_7\text{age\_dummy} + \beta_8\text{OwnerCEO} + \beta_9\text{Informal} + \beta_{10}\text{food} \\ &+ \beta_{11}\text{wood\_furniture} + \beta_{12}\text{non\_metallic} + \beta_{13}\text{metals\_othermanuf} + \beta_{14}\text{retail} + \beta_{15}\text{hotels} \\ &+ \beta_{16}\text{Zonal\_dummy} + \mu \ldots\ldots 1.1\end{aligned}$$

Variable definitions are given in table A8 in the appendix to the present work. We used the total weight per size in each state (weight_size) in the estimations because it more appropriately accounts for over- or under-representation of firms of different categories in each state and thus makes the data nationally representative.

3.2.2 Explaining the gender credit gap: Nonlinear decompositions

If a gender gap exists, further decomposition of it into explained and unexplained components would give more insight into what causes this gender gap in credit access. In order to accomplish this, we employ the methods of decomposing inequality into contributing factors. The core idea is to explain the distribution of the outcome variable in equation (1.1) by a set of factors that vary systematically with firm characteristics (the covariates). We thus adopted the extended decomposition technique proposed by Fairlie (2003), which is more appropriate for decomposing binary outcomes. The Oaxaca (1973) decomposition technique cannot be used directly for binary outcomes and also if the coefficients come from probit and logit models. The method to perform such nonlinear decompositions was first described by Fairlie (1999) and the discussion was extended in Fairlie (2003). Following Fairlie (1999 and 2003), the decomposition for a nonlinear equation such as $Y = F(X\hat{\beta})$, can be specified as:

$$\bar{Y}^W - \bar{Y}^M = \left[\sum_{i=1}^{W} \frac{F(X_i^W \hat{\beta}^M)}{N^W} - \sum_{i=1}^{N^M} \frac{F(X_i^M \hat{\beta}^M)}{N^M}\right] + \left[\sum_{i=1}^{N^W} \frac{F(X_i^W \hat{\beta}^W)}{N^W} - \sum_{i=1}^{N^W} \frac{F(X_i^W \hat{\beta}^M)}{N^W}\right] \ldots\ldots 1.2$$

where N_j is the sample size for group j. To calculate the decomposition, define $\bar{Y}^j$ as the average probability of being credit constrained for group *j* and *F* as the cumulative distribution function from the standard normal distribution. In the above decomposition W represents women entrepreneurs and M represents men entrepreneurs. Again, following Fairlie (2003), in equation (1.2) the first term in brackets represents the part of the gender credit gap that is due to group differences in distributions of *X (covariates)*, and the second term represents the part due to differences in the group processes determining levels of *Y*. The second term also captures the portion of the gender credit gap due to group differences in unobserved endowments.[1]

[1] We estimated the decompositions using the Stata command 'fairlie'.

3.2.3 Impact of credit constraint on the performance of (women) entrepreneurs: Propensity score matching (PSM)

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 approach. We used this approach to be able to quantify the average effect related to credit constraint by matching credit constrained firms with firms that have similar characteristics but which 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 and 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.

For formal presentation of the PSM, let the dummy variable D_i be equal to one if firm *i* is a treated firm (a credit constrained firm) and zero if not. Y_{i1} and Y_{i0} are the outcome variables or performance indicators (e.g., employment, output per worker, capital per worker, etc.) for firm *i* conditional on the presence and absence of treatment respectively. The treatment effect for firm *i* measures the difference in the relevant outcome indicator with and without treatment. This is given by the following expression:

$$\Delta Y_i = E(Y_{i1}/D_i = 1) - E(Y_{i0}/D_i = 1) \quad \text{.....1.3}$$

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 $E(Y_{i0}/D_i = 0)$ 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 is 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, the conditional independence assumption (CIA) and the 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:

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

This 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. I.e.,

$$E(Y_{i0}/D_i = 1, X_i) = E(Y_{i0}/D_i = 0, X_i)$$

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 becomes a one-dimensional problem written as:

$$P(X_i) = \Pr\{D_i = 1/X_i\}$$

Hence, the counterfactual can be estimated as:

$$E[Y_{i0}/D_i = 1, P(X_i)] = E[Y_{io}/D_i = 0, P(X_i)],$$

and thus the average treatment effect for firm *i* can be measured by the following:

$$\Delta Y_i = E[Y_{i0}/D_i = 1, P(X_i)] - E[Y_{io}/D_i = 0, P(X_i)] \quad \text{.....1.4}$$

Once we have estimated the propensity scores, we select matching estimators that describe how comparison units relate to treated units. Dehejia and Wahha (2002) argue that such matching on propensity scores determines what weights are placed on comparison 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 outcomes are not influenced by treatment assignment, our choices 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 of interest:

$$\begin{aligned} \text{constraint1\_1} &= \beta_1 \text{gender} + \beta_2 \text{age} + \beta_3 \text{expere} + \beta_4 \text{status} + \beta_5 \text{ownerCEO} + \beta_6 \text{ children10} \\ &+ \beta_7 \text{informal} + \beta_8 \text{ finacial\_statement} + \beta_9 \text{educ\_sec} + \beta_{10} \text{ igeoregion} * + \beta_{11} \text{ food} \\ &+ \beta_{12} \text{garments\_textile} + \beta_{13} \text{ wood\_furniture} + \beta_{14} \text{ non\_metallic} + \beta_{15} \text{metals\_othermanuf} \\ &+ \beta_{16} \text{retail hotels} + \beta_{17} \text{ construction\_others} + \mu \quad \text{.....1.5} \end{aligned}$$

3.2.4 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 this conditional independence 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 unconfoundedness 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 quite inevitable in any good study.

Following Becker and Caliendo (2007), let the participation probability be given by $P_i = P(X_i, \mu_i) = P(D_i = 1/X_i, \mu_i) = F(\beta X_i + \gamma\mu)$, where X_i ,*i*, μ_i , is the unobserved variable and γ is the effect on μ_i with respect to 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:

$$\left(\frac{\frac{p_i}{1-p_i}}{\frac{p_j}{1-p_j}}\right) = \frac{p_i(1-p_j)}{p_j(1-p_i)} = \frac{\exp(\beta x_i + \gamma\mu_i)}{\exp(\beta x_j + \gamma\mu_j)} \quad \text{.....1.6}$$

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

$$\frac{\exp(\beta x_i + \gamma\mu_i)}{\exp(\beta x_i + \gamma\mu_j)} = \exp(\gamma(m_i - \mu_j)) \quad \text{.....1.7}$$

Still, 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 (μ_i-μ_j).

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

$$\frac{1}{e^{\gamma}} \leq \frac{P_i(1-P_j)}{P_j(1-P_i)} \leq e^{\gamma} \quad \text{.....1.8}$$

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 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 (less than 2), it is likely that such an unobserved characteristic exists and therefore that the estimated treatment effect is sensitive to unobservable. We calculated the Hodges-Lehmann point estimates as well as the 95% confidence intervals for the continuous outcomes using the round command in Stata and the results are reported in table A6 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.

3.2.5 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 establishments (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 firm sizes. The data is thus nationally representative and the survey was drawn from all geopolitical zones. The data covers large-, medium- and small-scale enterprises with about 422 firms owned by women entrepreneurs either as 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 – establishment has sufficient capital." The instrument also asked questions such as whether the establishment has an overdraft facility, the proportion of financing from different sources (formal or informal), 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 few manufacturing firms as Hansen and Rand (2014) did in their study. The advantage of doing this is that most women entrepreneurs in the micro/small establishment 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 discrimination 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 (variable weight_reg), the total weight per size in each state (variable weight_size) and the single weight per stratum in each state (variable weight_est). We chose the total weight per size in each state since this would normalize sample variation in each state.

IV. 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 shows that the credit unconstrained firms have higher means. For example, average outputs per worker, capital per worker and purchases of fixed assets are significantly higher for credit unconstrained firms regardless of the size. Also, credit unconstrained firms at the micro enterprise level are far more oriented towards informal sector loans. Surprisingly, credit constrained firms on keep financial records more so on average than firms that are unconstrained.

Table A2 shows the actual descriptive statistics between constrained and unconstrained firms. At the medium-sized level, more women-owned firms are credit constrained than otherwise. The reverse is the case with micro enterprises, among which women-owned firms are more often credit unconstrained. Credit unconstrained firms on average employ more full-time workers compared to the credit constrained firms. Credit constrained and unconstrained firms both have a similar household demographic structure as captured by the number of children under 10 years of age. 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 women who owned firms have significantly higher average of level of education above secondary, have higher average of being in a sole proprietorship businesses and hence higher average of being their own CEOs. Women entrepreneurs on average use more informal credit than men. Firms in garments and textiles are most often owned by women entrepreneurs.

4.2. Estimates of credit constraint

Table 1 reports the probit model of credit constraint and the corresponding marginal effects. The results are arranged by micro and medium enterprises and the combination of both. The dependent variable takes a value of 1 for credit constrained and 0 otherwise. The results show no statistically significant difference in access to formal credit in Nigeria by gender regardless of firm size. This suggests no evidence of discrimination against women using the direct measure of credit constraint. This result is contrary to the findings by Hansen and Rand (2014) for manufacturing firms in Sub-Saharan African countries using the same enterprise dataset. In Hansen and Rand (2014), there is a statistically significant gender effect in their results across all firm sizes, and according to Hansen and Rand (2014, p.89) "In most cases, a statistically significant pure gender effect, shows that the mean gap is in all likelihood caused by some form of favouritism vis-à-vis women-owned firms" (see Hansen and Rand (2014), pp. 89-90). However, in our result gender has no statistical significance across all firm sizes.

The results show that the effect of age on the probability that a firm will be credit constrained is statistically significant and firms with aging owners are 13 to 15.6 percentage points more likely to be credit constrained. On the other hand, firms with experienced managers are significantly less likely to be credit constrained, other things being equal. Even though the marginal effect of years of experience is small (ranging between 0.5 to 0.7%), it is statistically significant for all firm sizes. This suggests that experienced managers can manage the firm's financial and credit policies better than inexperienced ones. Experienced managers are more likely to understand application procedures better and thus their loan applications are less likely to be rejected.

Firms whose top owner is also CEO are 10.4 percentage points more likely to be credit constrained and this is statistically significant at the 10% level of significance only when medium and micro enterprises are combined into one sample. This may be related to risk-averse policies the owner may adopt because most entrepreneurs are quite sceptical of taking bank loans in Nigeria. As the descriptive statistics show, the owner CEOs are more common among sole proprietorship businesses and a significant number of these firms is owned by women. The probit estimates further show that firms with good financial records have significantly less probability of being credit constrained and this may be as low as 27.3 percentage points for medium-sized firms. The results also suggest that firms that patronise the informal market face significant credit constraint in formal credit markets. This may be attributed to the fact that those firms are not able to present good collateral requirements in formal credit markets. As a result, such firms find it more convenient and easier to borrow from informal sources, in a process which may be less rigorous and stressful than accessing formal credits.

Overall, if the owner has at least secondary education, the probability of facing credit constraint in the formal credit market is about 6 percent lower on average. Again, this is weakly significant, at the 10% level, for the combined sample. Educated owners are better able to gather and utilise credit information than owners with little or no education. As a result, a higher level of

education of the firm owner decreases the likelihood of credit constraint since this enhances the ability to comply with application procedures as well as to understand the structure of the financial market. Regional and industry characteristics are also significant in explaining credit constraint. Entrepreneurs in garments and wood industry face significant credit constraint compared to the construction industry in Nigeria. The summary statistics shows that average of women-owned firms is significantly larger in garments and textiles than men-owned firms.

Table 1: Probit estimates of determinants of credit constraint and their marginal effects

	Prob2_all	Marg2_all	Prob2_micro	Marg2_micro	Prob2_medium	Marg2_medium
Credit constraint = 1						
Sole prop / maj. shareholder is fem. = 1[d]	0.0635	0.0173	0.0561	0.0146	0.258	0.0835
	(0.658)	(0.652)	(0.717)	(0.712)	(0.426)	(0.390)
Age >= 45 =1[d]	0.522***	0.135***	0.539***	0.131***	0.439**	0.156**
	(0.000)	(0.000)	(0.001)	(0.000)	(0.029)	(0.031)
Yrs. experience	-0.0182**	-0.00506**	-0.0181*	-0.00481*	-0.0218*	-0.00753*
	(0.032)	(0.033)	(0.057)	(0.058)	(0.073)	(0.075)
Sole proprietor = 1[d]	0.184	0.0540	0.152	0.0425	0.305	0.110
	(0.346)	(0.372)	(0.508)	(0.529)	(0.153)	(0.167)
Owner is CEO = 1[d]	0.279*	0.0837	0.302	0.0886	0.219	0.0764
	(0.084)	(0.105)	(0.120)	(0.151)	(0.240)	(0.246)
Owner w/ch.<10 yrs.=1[d]	0.0678	0.0190	0.0409	0.0109	0.495**	0.176**
	(0.570)	(0.574)	(0.756)	(0.758)	(0.014)	(0.015)
Has used informal credit = 1[d]	0.371**	0.0916**	0.382**	0.0897**	0.175	0.0579
	(0.033)	(0.014)	(0.041)	(0.018)	(0.544)	(0.526)
Produces finan. statement = 1[d]	-0.362***	-0.0968***	-0.356***	-0.0919***	-1.041***	-0.273***
	(0.002)	(0.002)	(0.004)	(0.003)	(0.000)	(0.000)
Educ: none:=; prim=1; sec=2; voc=3; tert=4[d]	-0.243*	-0.0630*	-0.241	-0.0597	-0.0212	-0.00731
	(0.092)	(0.074)	(0.125)	(0.103)	(0.933)	(0.933)
North-central[a]	-0.538***	-0.170***	-0.484**	-0.146**	-1.253***	-0.469***
	(0.003)	(0.006)	(0.015)	(0.026)	(0.000)	(0.000)
North-east[a]	-0.826***	-0.278***	-0.821***	-0.268***	-0.661*	-0.251*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.052)	(0.060)
North-west[a]	-0.365	-0.110	-0.370	-0.108	-0.310	-0.113
	(0.100)	(0.126)	(0.126)	(0.157)	(0.351)	(0.369)
South-east[a]	-0.395	-0.124	-0.462*	-0.144	0.476	0.143
	(0.103)	(0.139)	(0.084)	(0.122)	(0.267)	(0.186)
South-south[a]	0.0283	0.00780	0.0902	0.0234	-0.219	-0.0765
	(0.897)	(0.897)	(0.721)	(0.715)	(0.371)	(0.375)
Food sector[b]	-0.150	-0.0437	-0.227	-0.0655	0.0446	0.0153
	(0.661)	(0.677)	(0.592)	(0.620)	(0.890)	(0.889)
Garments/textiles sector[b]	1.519***	0.214***	1.728***	0.210***	0.910*	0.230***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.085)	(0.006)
Wood/furniture sector[b]	0.379	0.0937*	0.331	0.0791	0.739*	0.209**
	(0.108)	(0.070)	(0.213)	(0.167)	(0.073)	(0.018)
Non-metals manuf. sector[b]	0.0858	0.0231	0.0656	0.0170	-0.191	-0.0688
	(0.762)	(0.754)	(0.835)	(0.830)	(0.612)	(0.624)
Metals/other manuf[b]	0.0222	0.00613	0.0192	0.00508	-0.115	-0.0404
	(0.929)	(0.929)	(0.946)	(0.946)	(0.729)	(0.734)
Retail sector[b]	-0.512**	-0.161**	-0.594**	-0.184**	0.118	0.0397
	(0.025)	(0.042)	(0.021)	(0.040)	(0.718)	(0.711)
Hotels sector[b]	-0.0189	-0.00526	-0.0724	-0.0196	0.368	0.120
	(0.928)	(0.929)	(0.762)	(0.766)	(0.224)	(0.193)
Medium size =1	-0.341**	-0.0944***				
	(0.012)	(0.008)				
Observations	1301	1301	988	988	313	313
Pseudo R^2	0.148	0.148	0.156	0.156	0.160	0.160
chi2	167.7	167.7	131.4	131.4	64.28	64.28
P_corr						

Source: Authors computations

[a] South-west is reference group.

[b] Construction sector is reference sector.

[d] Marginal effect of change from 0 to 1 (p-values with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

-constant term omitted because of reported marginal effects.

-weight used in the estimation is proportional to size.

When the significant variables were interacted with gender in the regression (results not reported here), we did not find any statistically significant coefficient. This again suggests that there is no evidence of gender credit discrimination even after controlling for interaction between variables. A medium-size firm dummy variable shows them to be significantly less credit constrained in the formal credit markets compared to micro/small firms.

4.3. Fairly nonlinear decompositions

In order to test for the robustness of our probit estimates of no gender bias in credit access among entrepreneurs in small and medium enterprises in Nigeria, we carried out the Fairlie type decomposition of the small gaps observed in the regression to ascertain whether a particular component is statistically significant. This is reported in Table A5 in the appendix. The decomposition results are shown for micro/small enterprises, medium enterprises and for the combination of both. In the decompositions, a positive difference means that women are more favoured while a negative difference shows them to be less favoured. Again, the differences are not statistically different from zero. This reinforces our finding that women do not face discrimination in access to formal credit in Nigeria using the direct measure of credit constraint.

The results in table A5 show that the credit gap rises with age among women in formal credit markets for micro enterprises and decreases with age for women-owned medium-sized firms. However, type of industry and keeping proper financial records tend to favour women's credit access at the medium enterprise level. These findings suggest that even though we do not find overall significant bias in credit access by women in the formal credit market, differences in specific endowments or characteristics of enterprises owned by men and by women could account for most of the discrimination experienced by women in the formal credit markets.

4.4. Impact of credit on the performance of entrepreneurs: Propensity score matching (PSM)

The estimation of the propensity scores that satisfy the balancing property is the first step in applying the PSM technique. We estimated propensity scores for the men-owned and women-owned firms and both groups combined. The propensity score estimates are reported in table A6 in the appendix. All the estimated propensity scores satisfied the balancing property. The dependent variable takes a value of 1 when the firm is credit constrained and 0 otherwise. The covariates we used in the estimation of the PSM are the family demographics of the firm manager and owner, 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 records, indicator variables representing geopolitical zones in Nigeria and indicator variables denoting the industry type.

The treatment effects for the weighted kernel matching estimator are reported in table 2 together with the treatment effects from the nearest neighbour bias-adjusted estimator after conducting sensitivity analysis in the framework Rosenbaum bounds reported in table A7. The purpose of these results is to explain the impact of credit constraint on performance.

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 that face credit constraint in the formal credit markets have significantly lower capital per worker and acquisition of fixed assets compared to those that do not. Again, being credit constrained has an overall significant and negative impact on investment in fixed assets for all types of firms, and a significant negative impact on output per worker and capital per worker for women-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.

In terms of numbers and using the results from the kernel and nearest neighbour estimator, 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 for 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, the estimated value of capital per worker of women- and men-owned enterprises which are credit constrained is lower by about N3.3 and N1.52 million naira respectively compared to unconstrained firms (after taking the antilog of the ATT estimates reported for kernel estimates reported in table 2); when using the nearest neighbour estimation, capital per worker is about N4.43 million lower for women-owned firms. Again, investment in fixed assets is lower by about N1.98 million and N2.0 million for women- and men-owned enterprises respectively. Also, for firms that are credit constrained, output per worker is lower by 16.4 to 24.0 percent overall depending on the matching estimator. But this is much more pronounced for women-owned credit constrained firms, with reported per worker output being as much as 64 percent lower. Among man-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 a more significant impact of credit constraint. Hence access to credit is important for the survival of businesses in Nigeria.

Table A7 reports the results of Rosenbaum's procedure for the three different performance outcome indicators computed for the men-owned firms, women-owned firms and both groups combined. 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 different outcomes and subsamples used in the estimation.

A look at the results for output per worker for 'small and medium firms' shows 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 Hodges-lehmann point estimates, the value of tau that encompasses zero reaches 2.0 or 2.2 for men-owned small/medium enterprises. But when the women-owned small/medium firms are considered, we see that the lowest value of tau producing a 95% confidence interval encompassing zero for output per worker is 1 and is 1.4 for Hodges-lehmann point estimates. This shows that the treatment effect estimated for this variable for the subsample of women-owned firms is sensitive to the influence of unobservable factors. The large differences between the kernel and nearest-neighbour estimators for women-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 than the nearest-neighbour matching estimator performed using the Stata command nnmatch because 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 men-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 women-owned firms. The lowest Hodges-lehmann point estimates of capital per worker that encompass zero for these subsamples 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 women-owned firms, we may conclude that the influence of unobserved factors for this variable is not a problem. This is the reason why the estimated impacts on capital per worker using the kernel and nearest neighbour matching are similar among women-owned firms.

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

Table 2: Matching estimates of the impact of credit constraint on firm performance

Sample			Kernel		N/Neighb bias adj.	
	Treated	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
Men-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
Women-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
* significance at 10% level, ** significance at 5% level.
Notes: both the Kernel and nearest-neighbour estimators were estimated by considering the sampling weights. The Kernel estimator was estimated using the Stata command pscore 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 command nnmatch by Abadie et al. (2004)

V. Conclusions and policy Implications

The main object of this study is to ascertain whether women entrepreneurs experience discrimination in access to formal credit in Nigeria. Using direct measures of credit constraint, this study could not find any statistically significant discrimination against women in formal credit markets, and this at all evaluated firm sizes. This is evident by the non-significance of the gender coefficient in the probit estimations within different firm sizes as well as the absence of any statistically significant difference found in the Fairlie decomposition of the credit constraint by gender. These findings therefore differ from the findings of other studies that use cross-country Sub-Saharan African enterprise data (see for example Hansen and Rand, 2014 among others) to analyse gender credit discrimination. These findings are also consistent with the general belief that the Nigerian formal financial institutions (especially commercial banks) do not have any gender-targeted credit policy. However, while our results do not show evidence of statistically significant gender discrimination in the formal credit markets, access to formal credit by small and medium enterprises in Nigeria still remains very low at an average of 29 percent (as shown in our descriptive analysis). Hence, the objective of any credit policy in Nigeria should be to expand access to formal credit through education of entrepreneurs on how to access credit as well as targeting credit policy for geopolitical zones in Nigeria that are more credit constrained. Since micro/small firms are more credit constrained in formal credit markets compared to medium firms, government credit intervention in SMEs should give priority to small and micro enterprises. Most of the small and micro enterprises are owned by women.

Also, small and medium enterprises should be encouraged to keep good financial records of their transactions since this enhances a firm's ability to access formal credit. Lenders would prefer firms that keep good financial records since such records could help to ascertain the stream of income that flows into the firm and hence help to calculate the firm's credit repayment ability. We found that keeping good financial records decreases credit constraint by about 10% and by as much as 27% for medium enterprises.

From propensity score estimations, this study also shows that access to formal credit matters and significantly impacts 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. 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 24.0%, capital per worker is lower by about 23.0% and investment per worker is lower by about 31.2%. We also produce the corresponding nearest neighbour matching estimates for output per worker (16.4%), capital per worker (17.0%) and investment per worker (28.0%). Although the figure for capital per worker is not statistically significant after bias

correction for the overall estimation, it is statistically significant in the subsample of women-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 active credit channels work better in improving the performance of small and medium enterprises in the country and consequently, monetary policy should include measures to facilitate access to formal credit by small and medium enterprises as one of its priorities in Nigeria.

Although it is difficult for government to direct formal financial institutions to disburse credit to firms in a deregulated financial system, direct government involvement by the use of intervention funds targeted to small and medium enterprise would make an impact. For example, the Nigerian government has released more than N400 billion in intervention funds through the Central Bank and the Bank of Industry. More recently the Governor of Central Bank of Nigeria announced the release of N220 billion naira 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 treated and control groups (unconstrained and constrained)

Variables	Micro/medium (constrained-unconstrained)		Micro/small (constrained-unconstrained)		Medium (constrained-unconstrained)	
Female sole prop. / maj. shareholder = 1	-0.00918	(-0.41)	0.00691	(0.25)	-0.0375	(-1.08)
Yrs. experience	0.287	(0.61)	0.285	(0.53)	0.212	(0.22)
Educ.: none=0; prim=1; sec=2; voc=3; tert=4	0.0808***	(3.21)	0.110***	(3.69)	-0.0113	(-0.25)
Sole proprietor = 1	-0.0499*	(-2.51)	-0.0285	(-1.42)	-0.0827	(-1.66)
Age >=45 = 1	3.661***	(4.92)	-0.351***	(-5.71)	-0.0827	(-0.90)
Owner is CEO = 1	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)
Owner w/child<10 years=1	-0.0341	(-1.16)	-0.0306	(-0.89)	-0.0465	(-0.81)
Log(output)/worker	-0.339***	(-7.64)	-0.261***	(-4.68)	-0.443***	(-6.34)
Log(capital)/workers	-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)
Current period fixed invest.=1	-0.207***	(-9.23)	-0.226***	(-8.26)	-0.125***	(-3.37)
Firm has used informal credit =1	-0.0536**	(-2.59)	-0.0624*	(-2.48)	-0.0183	(-0.53)
Prod. fin. statement = 1	0.185***	(6.24)	0.180***	(5.10)	0.133**	(3.17)
Food sector[a]	0.0314*	(1.99)	0.0215	(1.41)	0.0397	(0.94)
Garments/textiles sector[a]	-0.0630***	(-4.62)	-0.0714***	(-4.39)	-0.0379	(-1.53)
Wood/furniture[a]	-0.0832***	(-3.87)	-0.0790**	(-3.04)	-0.0853*	(-2.33)
Non-metals manuf. sector[a]	0.00563	(0.35)	-0.00215	(-0.11)	0.0294	(0.98)
Metals/other manuf. sector[a]	0.0134	(0.62)	-0.0178***	(-0.70)	-0.102*	(2.44)
Retail sector[a]	0.106***	(4.61)	0.144***	(5.31)	0.00623	(0.15)
Hotels sector[a]	-0.00952	(-0.36)	0.0205	(0.66)	-0.0935	(-1.82)
N	1302		988		314	

Source: Authors' computations

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

[a] Construction sector is reference secto

Table A2: Summary Statistics of the Variables by Treated and Untreated and Firm Size

Variable	Micro and medium enterprises			Micro enterprises			Medium enterprises		
	Uncons-trained	Constrained	Total	Uncons-trained	Constrained	Total	Uncons-trained	Constrained	Total
Female sole prop. / maj. shareholder = 1	0.150	0.159	0.157	0.182	0.175	0.177	0.0673	0.105	0.0924
Yrs. Experience	12.06	11.75	11.83	11.94	11.65	11.73	12.30	12.09	12.16
Educ.: none=0; prim=1; sec=2; voc=3; tert=4	0.842	0.761	0.784	0.851	0.741	0.771	0.817	0.829	0.825
Sole proprietor = 1	0.842	0.894	0.880	0.892	0.921	0.913	0.721	0.804	0.776
Age >=45 = 1	0.287	0.396	0.365	0.160	0.316	0.273	0.615	0.671	0.653
Owner is CEO = 1	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
Owner w/ch.<10yrs=1	0.614	0.648	0.638	0.613	0.644	0.636	0.615	0.662	0.646
Log(output)/worker	13.81	13.45	13.55	13.69	13.41	13.49	14.11	13.56	13.74
Log(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
Current per. fixed invest.=1	0.781	0.438	0.536	0.781	0.381	0.490	0.779	0.633	0.682
Firm used informal credit=1	0.0938	0.147	0.132	0.100	0.163	0.146	0.0769	0.0952	0.0892
Prod. fin. statement =1	0.727	0.541	0.594	0.643	0.463	0512	0.942	0.810	0.854
Food [b]	0.0938	0.0624	0.0714	0.063	0.0417	0.0476	0.173	0.133	0.146
Garments/textiles [b]	0.00804	0.0710	0.0530	0.0037	0.0751	0.0556	0.0192	0.0571	0.0446
Wood/furniture [b]	0.0858	0.169	0.145	0.100	0.179	0.158	0.0481	0.133	0.105
Non-metals [b]	0.0777	0.0721	0.0737	0.0743	0.0765	0.0759	0.0865	0.0571	0.0669
Metals/other manuf. [b]	0.155	0.143	0.146	0.134	0.152	0.147	0.212	0.110	0.143
Retail [b]	0.249	0.143	0.174	0.286	0.142	0.181	0.154	0.148	0.150
Hotels [b]	0.241	0.251	0.248	0.264	0.243	0.249	0.183	0.276	0.245
Construction/others [b]	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

[b] Economic sector of activity

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)	
Credit constraint=1	-0.0142	(-0.41)	0.00940	(0.25)	-0.0990	(-1.08)
Yrs. experience	1.469***	(6.59)	1.431**	(2.92)	1.545	(1.47)
Educ.: none=0; prim=1; sec=2; voc=3; tert=4	-0.0459*	(-2.00)	-0.0414	(-1.55)	-0.0990*	(-2.15)
Sole proprietor = 1	-0.0714***	(-3.50)	-0.0497**	(-2.57)	-0.0661	(-1.17)
Age >=45 = 1	0.189***	(6.59)	0.130***	(4.21)	0.235***	(3.91)
Owner is CEO = 1	-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)
log(output)/worker	0.196***	(3.44)	0.164*	(2.50)	0.170	(1.48)
log(capital)/worker	0.159*	(2.17)	0.0904	(1.13)	0.467**	(2.61)
Acquired land	0.0162	(0.65)	0.0112	(0.40)	0.0270	(0.48)
Current pd. fixed inv.=1	0.0438	(1.51)	0.00813	(0.25)	0.0582	(0.96)
Firm used informal credit=1	-0.0338*	(-1.97)	-0.0341	(-1.64)	-0.00270	(-0.09)
Prod. fin. statement = 1	0.0612*	(2.19)	0.00907	(0.28)	0.102*	(2.15)
Food [b]	0.0174	(1.17)	0.0113	(0.82)	-0.00642	(-0.15)
Garments/textiles [b]	-0.0772***	(-5.52)	-0.0698***	(-4.24)	-.0968***	(-3.55)
Wood/furniture [b]	0.109***	(5.31)	0.153***	(6.27)	-0.0128	(-0.34)
Non-metals [b]	0.0236	(1.53)	0.0271	(1.48)	0.0276	(0.94)
Metals/other manuf.[b]	0.171***	(7.83)	0.196***	(7.72)	0.114**	(2.60)
Retail [b]	-0.0331	(-1.55)	-0.0424	(-1.72)	0.0200	(0.45)
Hotels [b]	-0.165***	(-6.84)	-0.200***	(-7.74)	-0.0840	(-1.44)
Construction/other [b]	-0.0457**	(-2.93)	-0.0749***	(-4.70)	0.0386	(0.95)
N	2618		1844		774	

Source: Authors' computations

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

[b] Economic sector

Table A4: Summary statistics of the variables by gender and firm size

Variable	Micro and medium			Micro enterprises			Medium enterprises		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Credit constraint=1	0.711	0.725	0.714	0.729	0.720	0.728	0.660	0.759	0.669
Yrs. experience	12.21	10.74	12.02	12.16	10.73	11.95	12.30	10.76	12.17
Educ.: none=0; prim=1; sec=2; voc=3; tert=4	0.801	0.847	0.807	0.783	0.825	0.790	0.840	0.939	0.849
Sole proprietor = 1	0.846	0.918	0.856	0.896	0.945	0.903	0.737	0.803	0.743
Age >= 45 yrs. = 1	0.462	0.274	0.438	0.360	0.230	0.341	0.689	0.455	0.669
Owner is CEO =1	0.773	0.876	0.787	0.861	0.912	0.868	0.581	0.727	0.593
Employees	16.05	13.21	15.68	9.194	9.117	9.183	31.25	30.18	31.16
Owner w/ch.<10 yrs. =1	0.675	0.609	0.666	0.684	0.602	0.672	0.654	0.636	0.652
log(output)/worker	13.67	13.47	13.64	13.58	13.42	13.56	13.85	13.68	13.83
log(capital)/worker	10.15	9.993	10.13	10.14	10.05	10.13	10.19	9.723	10.13
Acquired land	0.243	0.226	0.241	0.237	0.226	0.236	0.254	0.227	0.252
Curr. pd. fixed inv.=1	0.526	0.482	0.520	0.457	0.449	0.456	0.679	0.621	0.674
Firm used inf. credit=1	0.093	0.126	0.097	0.108	0.142	0.113	0.0579	0.0606	0.058
Prod. fin. statement=1	0.644	0.582	0.636	0.553	0.544	0.552	0.845	0.742	0.836
Food [b]	0.073	0.0559	0.071	0.0478	0.0365	0.0461	0.130	0.136	0.130
Garments/textiles [b]	0.052	0.129	0.062	0.0580	0.128	0.0683	0.0395	0.136	0.0478
Wood/furniture [b]	0.162	0.0529	0.148	0.193	0.0401	0.170	0.0932	0.106	0.0943
Non-metals [b]	0.0794	0.0559	0.076	0.0892	0.0620	0.0851	0.0579	0.0303	0.0556
Metals/other manuf. [b]	0.197	0.0265	0.175	0.222	0.0255	0.193	0.144	0.0303	0.134
Retail [b]	0.158	0.191	0.162	0.166	0.208	0.172	0.141	0.121	0.140
Hotels [b]	0.205	0.371	0.227	0.172	0.372	0.202	0.280	0.364	0.287
Construction/other [b]	0.072	0.118	0.078	0.0529	0.128	0.0640	0.114	0.0758	0.111
Observations	2618			1844			774		

Source: Authors' computations

[b] Economic sector of activity

Table A5: Fairlie nonlinear decomposition of gender credit constraint

Variable	Micro	Medium	Both
Model:			
Pr(Y!=0G=0,woman)	0.772	0.657	0.762
Pr(Y!=0G=1, man)	0.726	0.760	0.728
Difference	0.046	-0.103	0.033
Total explained	0.057	-0.021	0.052
Explained by:			
Age >= 45	.018**	.0394*	.0203**
Years of experience	-0.005	-0.003	-0.004
Sole proprietor / maj. owner	-0.006	-0.003	-0.007
Owner is CEO	-0.003	-0.006	-0.004
Owner w/ch. < 10 yrs.	-0.0001	0.005	-0.0002
Firm used informal credit	0.006	-0.001	0.005
Produces fin. statement	0.004	-.0125*	0.003
Educ.: none=0; prim=1; sec=2; voc=3; tert=4	0.004	0.0015	0.005
Region	.0331***	-0.011	.0302***
Industry	0.004	-.0343*	0.004

Source: Authors' computations

Table A6: Propensity score estimates

	Psmodel_all	Psmodel_male	Psmodel_femal
Sole prop / maj. shareholder is female=1	0.125		
	(0.268)		
Age >= 45 yrs = 1	0.482***	0.529***	0.540*
	(0.000)	(0.000)	(0.085)
Yrs. experience	-0.0186***	-0.0170***	-0.0437***
	(0.001)	(0.008)	(0.009)
Sole proprietor =1	0.318***	0.363***	-0.355
	(0.008)	(0.004)	(0.460)
Owner is CEO = 1	0.238**	0.269**	0.326
	(0.030)	(0.024)	(0.334)
Owner w/ch.<10 yrs.=1	0.103	0.0711	0.107
	(0.226)	(0.441)	(0.674)
Firm used informal credit=1	0.317**	0.287**	0.445
	(0.012)	(0.033)	(0.275)
Financial statement	-0.544***	-0.540***	-0.695***
	(0.000)	(0.000)	(0.004)
Educ.: none=0; prim=1; sec=2; voc=3; tert=4	-0.286***	-0.309***	-0.0137
	(0.007)	(0.006)	(0.968)

South_west	-0.152		0.123
	(0.433)		(0.793)
North_central	-0.398**	-0.267*	-0.113
	(0.031)	(0.067)	(0.809)
North_east	-0.677***	-0.493***	-0.422
	(0.000)	(0.001)	(0.303)
North_west	-0.285	-0.120	
	(0.138)	(0.451)	
South_south	-0.0197	0.181	0.0558
	(0.916)	(0.236)	(0.902)
Food[b]	-1.345***	-1.221***	-0.00170
	(0.000)	(0.000)	(0.999)
Wood/furniture[b]	-0.645**	-0.393	-0.384
	(0.035)	(0.221)	(0.660)
Non/metals[b]	-1.041***	-0.873***	0.257
	(0.001)	(0.010)	(0.766)
Metals/other manuf[b]	-1.051***	-0.928***	
	(0.001)	(0.003)	
Retail[b]	-1.321***	-1.159***	-0.0779
	(0.000)	(0.000)	(0.923)
Hotels[b]	-0.898***	-0.878***	0.903
	(0.002)	(0.005)	(0.260)
Construction/others[b]	-0.860***	-0.766**	0.731
	(0.006)	(0.022)	(0.378)
georegion==South_east		0.183	0.0142
		(0.388)	(0.979)
Constant	1.892***	1.546***	1.033
	(0.000)	(0.000)	(0.305)
Observations	1301	1097	188
Pseudo R^2	0.117	0.120	0.175
chi2	182.0	158.1	40.09
Corretly Classif	73.10%	72.93%	76.06%

p-values in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[b] Economic sector of activity

Table A7: Rosenbaum bounds sensitivity analysis. Treatment=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	12.641	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
Men-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
Women-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
	2.4	**-.951695**	**.005351**	-1.24009	.269878
Fixed assets*	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 (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 A8: Definitions of variables of the models we estimated

Variable	Definition and motivation
Constraint1_1	*Constraint1_1* is the credit constraint variable which takes the value of 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.
edu_sec	Education level of the owner (0 is no education, 1 primary, 2 secondary, 3 technical, and 4 tertiary education): We expect that managers with at 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	Financial Statement: 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.
status	This is an indicator variable showing the type of business ownership. We recoded as 1 if the firm is sole proprietorship and 0 otherwise. Financial firms are not well disposed to lend to single-owner firms than they are to partnerships and incorporated firms. The believe that in one man business the death of the owner may change the structure of the firm or even bring it to an end could affect the chances of such enterprises obtaining credit.
female	1 if the sole owner or majority shareholder is a female and 0 if male.
Owner CEO	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	Owner has children under age 10: as a control, children under 10 years of age accounts for the demographic structure of the household of the 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 like industries with regular cash inflows or turnover over industries with non-regular inflows.
Zonal dummy	"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 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 a value of 1 if the firm invested in fixed assets in the current period, and 0 otherwise.

Source: Authors' compilation