Efobi, Uchenna Rapuluchukwu et al.

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Environmental Pollution Policy of Small Businesses in Nigeria and Ghana: Extent and Impact [1]

Forthcoming: Environmental Science and Pollution Research

Uchenna Efobi
Covenant University, Nigeria
E-mail: uche.efobi@covenantuniversity.edu.ng

Tanankem Belmondo
Ministry of Economy, Planning and Regional Development,
Cameroon
E-mail: tanankemvoufo@yahoo.fr

Emmanuel Orkoh
North-West University, South Africa, and World Trade Organization, Geneva
E-mail: aorkoh@gmail.com

Scholastica Ngozi Atata
Federal University of Agriculture, Abeokuta Nigeria
E-mail: ngatata@gmail.com

Opeyemi Akinyemi
Covenant University, Nigeria
E-mail: opeyemi.akinyemi@covenantuniversity.edu.ng

Ibukun Beecroft
Covenant University, Nigeria
E-mail: ibukun.beecroft@covenantuniversity.edu.ng

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Research Department

Environmental Pollution Policy of Small Businesses in Nigeria and Ghana: Extent and Impact

Uchenna Efobi, Tanankem Belmondo, Emmanuel Orkoh, Scholastica Ngozi Atata, Opeyemi Akinyemi & Ibukun Beecroft

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Abstract

This study provides a comprehensive assessment of firms' operation and environmental protection polices in Nigeria and Ghana, where there has been a rising industrial growth amidst low regulatory and institutional frameworks. We analyze the extents to which firms' adoption of environmental protection policies affect their performances. We use firm-level data of 842 firms (447 for Nigeria and 395 for Ghana) distributed across different regions of both countries for our descriptive and econometric estimations. We find, among other things, that firms' adoption of internal policies on environmental protection is dismally low in both Nigeria (32 percent) and Ghana (17 percent), with policies focused on reducing solid (38 percent, Nigeria; and 35 percent, Ghana), gaseous (22 percent, Nigeria; and 44 percent, Ghana), and liquid (24 percent, Nigeria; and 14 percent, Ghana) pollution. Training appears to be an important intervention that can help improve firms' adoption of such policies. We also found that firms' adoption and implementation of environmental protection policies significantly improve their performance.

Keywords: Environment; Green Industrialization; Performance; Pollution; Small Businesses; West Africa
JEL Codes: H32; L25; Q52; Q53

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1. Introduction

Sustained policies towards environmental protection in Africa's unique business environment have become crucial since the continent is experiencing a rise in industrial growth characterized by increasing population of small businesses, entrepreneurs, and other firms involved in service delivery. Limited access to the needed infrastructure for efficient and environmentally friendly means of operation in the continent has also compelled most businesses to generate their own source of energy in the form of burning fossil fuel for electricity supply. In their desperate attempt to generate enough energy for their business operation and survival, these businesses may even be less conscious of the extent of emission that they generate and the consequences on plants and human life. Therefore, the limited access to infrastructure coupled with poor regulatory environment in most African countries may encourage firms to (un) consciously engage in pollution and inappropriate means of disposing industrial waste (solid, liquid and gas), which will consequently compound the already threatened environment.

To achieve sustained industrial development, countries in this region should consider green industrialization policies, which entail an industrial production process that is not at the expense of the health of natural systems; neither does it lead to adverse human health outcomes (United Nations Industrial Development Organization - UNIDO, 2011). This connotes two main issues, namely: an industrial production process that ensures environmental safety, and those that concern human protection. However, the extent to which business operations in Africa ensure the protection of natural systems and human health is not well known. Some countries in this region still experience rising rates of emissions as a result of both industrial and household activities. Nigeria, for instance, is among the top carbon emitters in Africa with annual CO2 emissions in excess of 10 metric tons of carbon. The rising rate of emission per capita in Ghana also raises concern as the country records increase in CO2 emissions (metric tons per capita) that almost doubled from 0.33 metric tons per capita in 2000 to 0.56 in 2013.

Given the rising industrial activities in Africa and the need to consider environmentally safe industrial processes in this region, this study investigates the extent to which small businesses in Nigeria and Ghana engage environmentally

conscious policies in their ordinary business operations and the effect of such policies on performance. Addressing the objectives of this paper is important for the following reasons:

First, the two countries have initiated regulatory frameworks to ensure environmental protection amidst rising industrial activities. For instance the Environmental Protection Agency (EPA) and its allied institutions are responsible for green industrialization in Ghana. While the National Renewable Energy Efficiency (NREE) policy for Nigeria was enacted in 2015 to stimulate demand for renewable energy in electricity production and distribution. In addition, both countries have initiated measures to regulate the management of industrial waste and other forms of environmental pollution from firms' activities. In spite of these public policy efforts, there is evidence that the level of policy enforcement is low in Africa in general, and in these two countries in particular (World Bank, 2016). This means that the enactment of public agencies may not be enough to reduce the environmental pollution by firms. Instead, sound researches on the activities of the firms that cause environmental pollution are essential in identifying the challenges that they face in their attempt to implement environmental protection policies in their operations. This will help in designing self-regulating policies that will encourage firms to observe higher environmental standards. It is on this basis that this paper assess the issues of environmental protection from a firm perspective, by attempting to understand the extent to which firms engage in activities that affect the environment and the extent to which their performance are affected by such activities.

Second, there is a growing literature that have concluded that African countries are going to be most affected by the rising climate and environmental changes caused by human activities (see Asongu, 2018a; Asongu, 2018b). The United States Environmental Protection Agency (2018) reports that the main source of environmental pollution is from burning fossil fuel for energy generation, which arises from transport, industry, and household activities. In most of these countries (e.g., Nigeria and Ghana) most industrial activities rely on high demand for substitute fossil fuels (that are subsidized by government) for self-generated electricity (Akpan and Akpan 2012; Asongu, El Montasser, and Toumi, 2015). In Nigeria, small businesses comprise about 90percent of the total manufacturing and industrial sector

(see Oyelaran-Oyeyinka, 2007; Efobi, Beecroft, and Belmondo, 2018), while in Ghana; they play a major role in the economic activities across all sectors. The potential contribution of these small businesses to the rising environmental pollution in Africain general and these two countries in particular cannot be underestimated (see Asongu, El Montasser, and Toumi, 2015; Asongu, 2018a). This paper is therefore relevant by considering efficient policies on sustainable industrial development from the perspective of small and medium scale businesses.

In addressing these research and policy relevant issues, we used data from a survey of small and medium scale enterprises in Nigeria and Ghana. We find from the analysis that indeed small businesses[2]are less likely to have policies that consider environment protection. While 39 percent of the surveyed firms in Nigeria have such policies, only 16 percent have similar policy in Ghana. Regarding the relationship between the adoption of the policies and the performance of the small businesses, we find from both matching technique and a battery of other robustness tests, that firms that consider environmental protection policies in their operations perform better than their counterparts who do not adopt such policies.

These relationships follow logical expectation that firms' adoption of environmentally friendly policies improves competitiveness stemming from firm efficiencies (i.e. performance growth and productivity). Indeed, the implementation of some environmentally friendly policies can have high initial costs, however, firms will be able to make up for this by avoiding fines, poor societal perception that can affect the acceptance of their services or products by potential customers, and other economic costs that are associated with negative environmental impact. Firms are also better able to position themselves within their industry by improving image of their brands and consequently gain an advantage in market share (Sharma, 2000; Currin, 2012). In other instances, adopting environmental protection policies can reduce firms' operational cost. Earnhart and Lizal (2011), for instance, notes that in scenarios where firms invest in more efficient production processes, such investments help to reduce operational cost since they require less energy, generate less waste, and demand fewer toxic inputs. Furthermore, regulatory scrutiny are reduced as a result of investing in environmentally friendly policies, which should lower the costs associated with

[2] A generic term used specifically in this paper to connote those enterprises that are not large.

regulatory sanctions, third-party lawsuits, and emission charges, and even community pressure that mounts up as a result of pollution by firms that are not environmentally conscious (Klassen and McLaughlin, 1996; Earnhart, 2004; Konar and Cohen, 2001).

The results from our study contribute to the broad literature on sustainable industrialization, which is largely focused on two main narratives. The first considers the effect of firm's activities on the quality of the environment (see Connor and Thomas, 2003; Shi and Zhang, 2006; Osabuohien *et al*, 2014; Asongu, 2018c; Asongu, 2018d). These authors emphasize the need for an environmental pollution framework in Africa that seriously considers the rising economic growth and industrial activities. The other body of literature has focused on understanding the extent to which environmental consciousness affect firms' performance. There is a growing interest in understanding the extent to which firm performance is affected by their environmental consciousness. This strand of literature argues that firms' environmental policies (which can suffice for social responsibility) have a direct effect on their corporate value. Earnhart and Lizal (2007) for instance analyze the effect of pollution control on corporate financial performance in transition economy and found that better pollution control by firms neither improves nor undermines financial success. The authors considered this effect through improved production processes that lowers cost and then improves profitability of firms in transition economy. A different analysis for Czech firms for 1996 to 1998 by Earnhart and Lizal (2010) found that a strong and robust relationship exist between better environmental performance and profitability through the reduction in costs. These relationships (in Earnhart and Lizal, 2007 and 2010) are seen in business environment where there are strong regulatory frameworks against environmental pollution. In such settings, the emission charge rates are reduced when firms are environmentally conscious. Manrique and Marti-Ballester (2017) yet in another study on the relationship between corporate environmental performance and corporate financial performance show that the adoption of environmental practices significantly and positively affects the financial performance of firms in developed and developing countries. This finding is also in agreement with the earlier conclusion of Qi *et al* (2014) that environmental performance influenced the financial performance of Chinese companies. Although these findings are very relevant for policy formulation and implementation, it is still

unclear how this relationship can be applicable in Nigeria and Ghana considering the numerous challenges that confronts small businesses in these countries, and the prevalent poor business regulatory environment. This paper highlights the efforts that small businesses in these countries are making to protect the environment and how such efforts affect their performance. Although this study focuses on only these two countries, the findings are equally applicable to other low-income countries.

The rest of this paper proceeds as follows: section two provides a background to the environmental pollution and its consequences in Africa, with more focus on some specific issues in Nigeria and Ghana. Section three provides a detailed description of the data, the variables and how they are measured, and the estimation technique. The fourth section presents the empirical results, while the discussion of this result is included in the fifth section. The sixth section concludes the paper with some policy recommendations.

2. Context: Environmental Pollution and its Consequences

Economic growth in Africa has been on an accelerating trend for more than thirty years. It is estimated that the average annual growth rate of real output increased from 1.8 percent between 1980 and 1989 to 2.6 percent between 1990 and 1999, and then further to 5.3 percent between 2000 and 2009. However, it has persisted within the range of 4.5 and 5.5 percent per annum since 2010. The contribution of the industrial sector to this growth has, however, remained low due to relatively little structural change in many African countries (Newman *et al*, 2016). According to the authors, the average share of manufacturing in GDP in Sub-Saharan Africa was about 10 percent in 2013, which is half of what would be expected from the region's level of development. More so, Africa's share of global manufacturing dropped from about 3 percent in 1970 to less than 2 percent in 2013. Similarly, manufacturing output per person is about a third of the average for all developing countries and manufactured exports per person, which is a key measure of success in global markets, is about 10 percent of the global average for low-income countries (Page, 2016).

In spite of the slow industrial growth and low manufacturing output, positive performance in a few country, and an increasing interest in foreign direct investment in the region suggest a potential for industrial takeoff. Such industrial growth has

much implication for environmental pollution and human health, as a significant proportion of air pollution stems from industrial activities (Karagulian *et al*, 2015). Even the African Union's Agenda 2063 and the United Nation's Sustainable Development Goals (SDGs) particularly support the agenda to reconcile industrialization, sustainable urbanization, and public health improvements in Africa (Roy, 2016).

Although studies on the sources of PM2.5 and PM10 remain limited in Africa, the few available studies indicate that 17 percent, 10 percent, 34 percent, 17 percent and 22 percent of PM2.5 levels in Africa are due to traffic, industrial activities, domestic fuel burning, unspecified sources of human origin and natural sources - such as dust and sea salt. With regards to PM10, the corresponding source distributions are 34 percent, 6 percent, 21 percent, 14 percent and 25 percent (Wichmann, 2017). It is further documented that outdoor (or "ambient particulate") air pollution from traffic, power generation and industries is increasing rapidly, especially in fast-developing countries in Africa such as Egypt, South Africa, Ethiopia and Nigeria. Other studies (e.g. Evans, 2015; Roy, 2016; United Nations Environment Programme, 2017) identify the industrial sector (thermal power stations, smelters, cement factories, chemical industries), transport sector, forest/savanna fires, domestic fuel use and waste burning as some of the key sources of air pollution in Africa. This rising pollution has significant cost on human capital. Estimates of the health and economic costs of air pollution in Africa by the Organisation for Economic Co-operation and Development (OECD) show that pollution causes more premature deaths than unsafe water or childhood malnutrition, and could develop into health and climate crisis as experienced in China and India. More so, premature deaths per year due to dirty air are 712,000, compared with approximately 542,000 from unsafe water, 275,000 from malnutrition and 391,000 from unsafe sanitation. Similarly, the estimated economic costs of premature deaths for the continent was around US$ 215 billion for outdoor air pollution, and about US$ 232 billion for household air pollution in 2013. According to Roy (2016), the estimated total annual deaths from Ambient particulate matter pollution (APMP) across the African continent increased by 36 percent from 1990 to 2013, from a relatively low number of 180,000 in 1990 to approximately 250,000 in 2013. Similarly, deaths from household air pollution from solid fuels

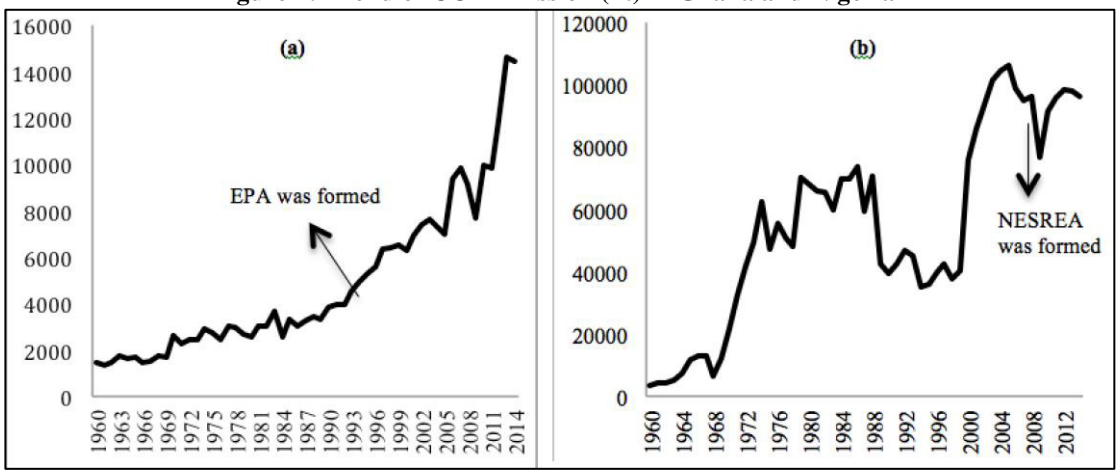
increased by 18 percent from an already high number of approximately 400,000 in 1990 to well over 450,000 in 2013.

Lack of data as well as poor regulation and ineffective implementation of laws on environmental pollution hampers an effective assessment of the prevalence of air pollution in Africa, the countries that have the worst air pollution levels, the main sources and drivers of air pollution, and how the main sources and drivers of air pollution differ from those of other regions(United Nations Environment Programme, 2017).South Africa is the only country in SSA that has an ambient air quality standards enforced by air quality laws and regulations. Other countries have either ambient air quality standards or air quality laws and regulations that are ineffectively enforced, while others do not have any at all.

In Nigeria and Ghana, for instance, the National Environmental Standards and Regulations Enforcement Agency (NESREA) and the Environmental Protection Agency (EPA) are the environmental regulatory agencies that are tasked with the responsibility of enforcing environmental protection laws. In spite of the existence of these bodies and laws, Figure 1, shows that the trend of carbon dioxide emission in these two countries have increased since the formation of these agencies. Though we do not claim strong causality in the trend, these statistics suggest that the extent to which environmental regulations in the two countries can curtail pollution is either minimal or insignificant. Which implies that at current regulatory framework, African countries (including Ghana and Nigeria) will benefit from sustainable industrialization that entails less pollution by effective participation of the private sector to consciously engage in practices that reduces pollution[3]. This was also echoed in Mbah and Nzeadibe (2016).

[3]There are many factors that can be considered for such participation to be effective; however, this is not the focus of this study.

Figure 1: Trend of CO2 Emission (kt) in Ghana and Nigeria



Source: Authors' Computation from World Development Indicators (2018)

The recent action in 2017 taken by the ECOWAS commission (the regional organization in West Africa), alongside the United Nations Environment Program, to partner with the private sector to develop strategies that will ensure environmental protection, further supports the private sector participation in ensuring sustainable industrial development. This paper therefore proceeds in this direction, to understand how firms participate in environmental protection, and the impact such will have on their performance.

3. Research Method

Data

The study relied on a survey on firms in the Southern regions of Nigeria and Ghana, from the period September to November 2017. These regions have the highest concentration of economic activities in both countries compared to the Northern region. Also, the security condition of the northern region of the countries constrained us to limit the study to the Southern region. In the case of Nigeria the data was collected from the three geo-political zones in the southern region, namely, the South-South, South-West, and South East, which comprise 17 states with similar cultural, economic, and historic background. The data from Ghana was gathered from six regions in the southern region, namely, the Western, Central region, Greater Accra, Volta, Eastern, and the Ashanti regions.

Using a sample frame of about 43,000 Small and Medium enterprises for Nigeria, and 79, 544 for Ghana, we compute the sample size as approximately 628 and 420 for each country, based on an assumed 5 percent margin of error, a z-score equivalent to 1.96, and a 95 percent confidence level. These samples were then distributed across the different states/regions of the two countries based on a proportional distribution weight, such that each state/region is assigned sample sizes depending on the number of SMEs reported in our sample frame. The sample frame and the actual sample size for Nigeria and Ghana are reported in Table 1.

Table 1: Sample Frame across Regions and Actual Sample Size[4]

	Nigeria	
State	Frame	Actual Sample
Abia	1,809	26
Anambra	1,737	25
Ebonyi	1,210	18
Enugu	911	13
Imo	1,394	20
AkwaIbom	1,093	16
Bayelsa	426	6
Cross River	1,294	19
Delta	1,444	21
Edo	1,997	29
Rivers	3,022	44
Ekiti	1,029	15
Lagos	11,663	171
Ogun	1,794	26
Ondo	1,999	29
Osun	2,272	33
Oyo	7,987	117
Total	43,081	628
	Ghana	
Western	9899	52
Central	7836	41
Greater Accra	23313	123
Volta	8658	46
Eastern	9086	48
Ashanti	20752	110
Total	79544	420

Note: We define SMEs as those manufacturing enterprises with a minimum of 10 workers.

The study followed layers of sampling process to arrive at the final sample size for the analysis. The first phase of the sampling process involved the use of the proportional sampling technique to identifying business enclaves within each states or region where businesses were located. Based on the number of businesses in each enclave, a

[4]The sample frame is gotten from Small and Medium Enterprises Development Agency of Nigeria and National Bureau of Statistics (2013). The actual sample is the Authors' computations.

simple random technique was used to select the individual firms that constituted the actual sample size for the analysis. Within each firm, the top manager(s) were contacted to fill the questionnaires[5].The study focused on these respondents because they could provide expert information on the activities and policies of the respective firms that were visited.

The survey instrument contains the following sections: Field information: (e.g. interviewer and supervisors name, information about quality assurance – responses edited by supervisor and interviewer, and whether the interviewer was accompanied by the supervisor) Contact information:(e.g. information regarding the name, level, email, phone number of contact person within the sampled firms); General information about the firm: this will contain information that relates to the firm formation and legal status, location, affiliation, ownership status, industrial classification, and etc. Firm characteristics: such as (a) asset structure, (b) ownership and board structure, (c) performance – monetary and market performance (d) labour (e) market participation (f) competition (g) firm expenditures; Green Industrialization (GI) characteristics: information such as (a) existence of GI policy (b) type of GI policy (c) date of forming the GI policy (d) plans for sustained or otherwise implementation of GI policy (e) expenditure on fossil fuel for energy (f) energy usage (i.e. fossil fuel generator set).

Measurement of Main Variables

The two main variables that are of interest to this study are the extent of firms' adoption of environmental protection policy, and the indicators of firm performance. The adoption of environmental protection policies is measured as a binary variable, which takes the value '1' if the firm has a policy that regulates its activities in relation to the environment or pollution, and 0 otherwise. We considered policies related to solid, liquid, and gaseous waste/pollution. We measure firm's performance using two main indicators, which are the profit/revenue and the productivity of the firm. The profit/revenue of the firm is measured as the annual US$ value of the profit/sale[6] of

[5]The survey instrument was developed through a modification of the World Bank Enterprise Survey instrument.

[6]The effective exchange rates (1 USD to local currency unit) as at the period of the survey are 360 (for Nigeria) and 4.59 (for Ghana).

the firm from its ordinary activities. We also measure productivity as the firm's total output to total factor input. This measure of performance has been used in the literature by many authors (see McArthur and Teal, 2002; Mesquita, Lazzarini, and Cronin, 2007; Arnold, Mattoo and Narciso, 2008;Lalinsky, 2013;Lopez-Gamero and Molina-Azorín, 2016; Efobi, Tanankem, and Beecroft, 2017).

Estimation Strategy

Two estimation techniques (the Propensity Score Matching (PSM), and then the instrumental variable regression technique for robust checks) were used for the econometric analysis.

We first use the PSM estimation method to quantify the impact of firms' adoption of environmental protection policies on their performance. The PSM identifies non-adopting firms who are similar to the adopting firms based on their observable characteristics, and then compute the difference in the respective outcome variables. It involves the estimation of the propensity score *[p(*x_i*)]* using the logistic regression to assess the likelihood that a firm will adopt such policies given its observed characteristics. This is represented in mathematical term as:

$$Pr(A_i = 1|X_i) = a_0 + a_1 X_i + \mu_i$$

(1)

In equation 1, A_i represents the probability that a firm will adopt an environmental protection policy given a vector of firm' characteristicsX_i. The variable μ_i represents the error term, while$i$,a_0 and a_1 represent firm identifier, the constant term, and a vector of the coefficients of the characteristics. The observed characteristics include country dummy, sector dummy, top managers education and experience in the particular industry, manager's knowledge of environmental protection, training on environmental pollution, firm's technology usage, and innovative capacity.The selection of the characteristics was informed by literature on the factors that influence internal policy decisions of small businesses (see Chell, 1985; Stewart *et al*, 1998; McMahon, 2001; Bridge, O'Neill and Cromie, 2003; Ayuso and Navarrete- Báez, 2017; Efobi and Orkoh, 2018).

There are several matching algorithms that can be used after the computation of the propensity scores. However, we applied three algorithms (i.e. the Nearest Neighbour Matching – NNM, the Kernel Matching – KM, and the Radius Matching technique – RM) for robustness checks. We test the respective impact using the bootstrapped standard errors, which takes into account the variation that is caused by the matching process. Further details about the different algorithms for the PSM estimations can be seen in Heckman, Hidehiko, and Todd (1997), Becker and Ichino (2002), Rosenbaum (2002), Caliendo and Kopeinig (2008).

In spite of its advantage of identifying causal relationships, the PSM has a downside of not being able to address the problem of hidden bias which occurs when there are unobserved variables that affect both the policy variable and the outcome variables (see Rosenbaum, 2002). For instance, it is possible that the PSM can produce over-estimated parameters in conditions where firms that adopt such policies are also more likely to improve their performance. We address this concern by first considering the inclusion of the important observable characteristics in specification of the equation for the estimation of the propensity scores to minimize the tendencies for omitted variable bias. Secondly, we implement the matching around the region of common support (see Heckman et al, 1997) and re-estimate the PSM by adjusting some key parameters. We finally use the instrumental variable (IV) regression to further assess the robustness of the PSM estimates.

Instruments for the IV Regression

Two instruments were used for the IV regression. They are: (i) a variable capturing the influence of government pressure on firms to set up environmental protection policies; (ii) the influence of stakeholders' demand on firm for environmental protection.

One of the major motivations for the choice of these instruments is that the governments of the two countries have some agencies that are mandated to ensure that firms comply with environmental guidelines, issue permits, among others (Page, 2015). Such agencies could influence firms' decision to adopt policies on environmental protection. Similarly, there are some firm specific changes that have been witnessed in the two countries as a result of stakeholders' protest or demand for

such changes. The case of the Niger-Delta region of Nigeria is very relevant, where firms that are involved in pollution and waste generation from their operation were compelled by public demand to engage eco-friendly production process. Yakubu (2018) documents instances where public pressure on firms in the Niger-Delta was caused by the rising volume of particle (soot) pollution. These instruments also conforms with the vast literature on the influence of government and stakeholders' pressure on firms' internal policies, including pollution (Roe, 2013;Wang and Wang, 2013; Lang and Murphy-Gregory, 2014; Chang, Li, and Lu, 2015).Apart from the justification for the use of these instruments, the estimates of the reliability tests of the instruments are reported alongside the IV regression results[7].

4. Presentation of Results

Description of the Survey

The discussion of the results proceeds with a brief description of the distribution of firms across their adoption status of environmental protection policies. As displayed in Figure 2, while the rate of small business adoption of this policy is 39 percent for Nigeria; it is only 16 percent for Ghana. The rate of adoption of this policy is low in the both countries, despite that this rate is higher for Nigeria compared to Ghana. It is important to also note that although there are no formal government policies on environmental pollution, the statistics (not reported) indicates that the majority of the firms that adopt such policies in Nigeria and Ghana do so as a result of some form of government interferences, and the decision of the management board to be socially responsible (31 percent). Other influencers of the decision to adopt environmental protection policy by firms include the quest to satisfy stakeholders (11 percent), influence of competitors (8 percent), trade union/association regulation and guidance (5 percent), and customer/suppliers demand (4 percent).

[7]We check the correlation of the instruments with the likely endogenous variable to understand whether the association is strong, then we perform the over-identification tests to check the validity of the instruments. These statistics are presented immediately after the econometric results on instrumental variable in Section 5.

Figure 2: Percentage of Firms with (without) Policy on Environmental Protection

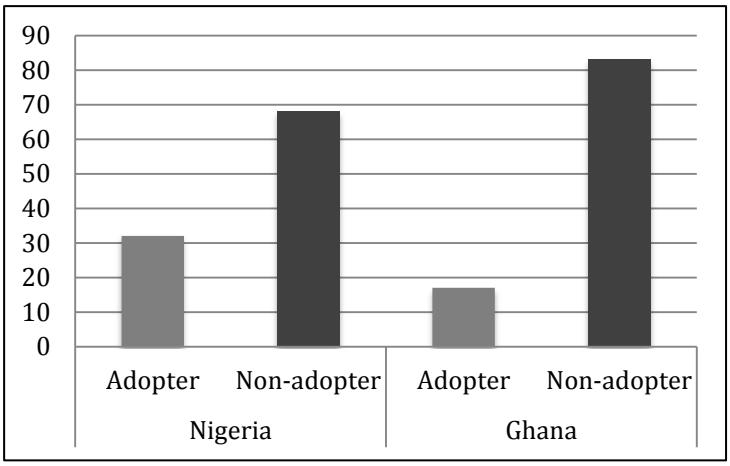
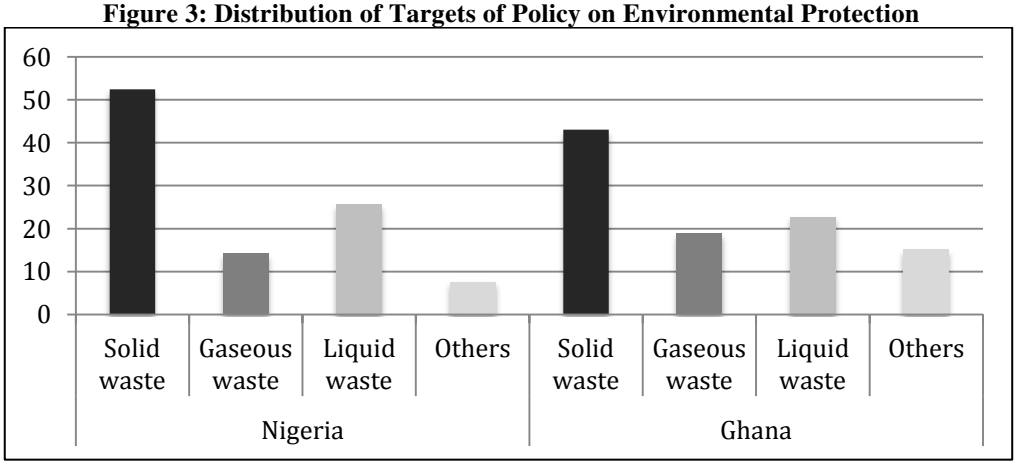


Figure 3 reports that small businesses in the two countries have similar focus of environmental protection policy. For instance, more of the small businesses in both countries tend to focus more on policies that reduce solid waste. About 38 and 35 percent of the sampled small businesses in Nigeria and Ghana have such functional policy. Furthermore, firms in both countries (i.e. 26 and 23 percent for Nigeria and Ghana respectively) have policies that relates to reducing liquid waste, while gaseous and other forms of waste are the least considered by these small businesses.

Figure 3: Distribution of Targets of Policy on Environmental Protection



For the small businesses that do not already have a policy on environmental pollution, we further ask whether they are considering having such policy in the nearest future – say in the next five years. From the statistics in Figure 4, we find that most small businesses in Nigeria do not have such future plans. Ghana survey presents a different outlook for potential adoption of environmental protection policies. The results indicate that 84 percent of the firms that do not currently have policies on

environmental protection plan to have such policies in the nearest future. This difference in the desire of small businesses to have (or not) environmental protection policies in the future shows the dismal interest of these businesses to consider how their activities affect the environment in Nigeria, while a much optimistic outlook is seen in Ghana.

Figure 4: Percentage of Firms without Policy on Environmental Protection and Plan to have such in the Future

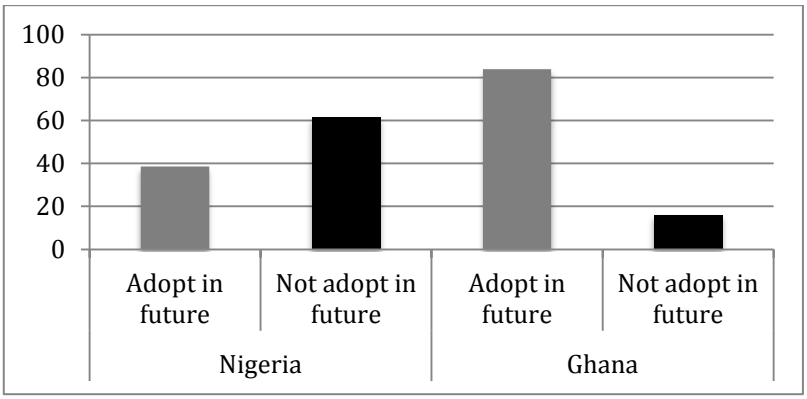
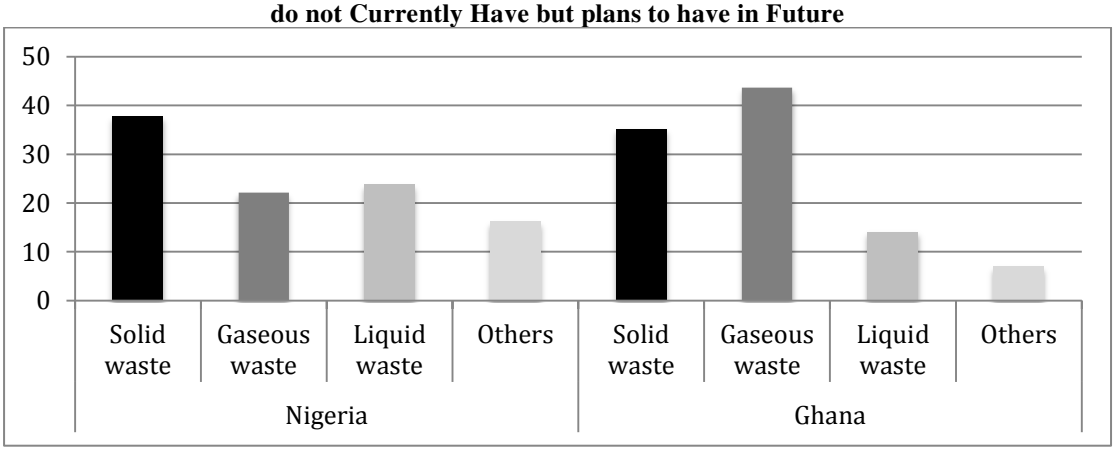


Figure 5 shows the policy focus of firms that do not previously have an environmental protection policy but intend to have one in the future. More of the Nigerian firms (38 percent) envisage that their future policies on environmental protection will focus on curtailing solid waste, while 24 percent intend focusing on reducing liquid waste. Only 22 percent of them intend their policies to focus on reducing gaseous waste, while 16 percent are focused on other forms of pollution. We also find from Figure 5 that more of the small businesses in Ghana that previously do not have environmental protection policies (44 percent) envisage that their future policies will be focusing on issues related to gaseous waste, followed by solid waste (35 percent), liquid waste (14 percent), and other forms of waste (7 percent). These statistics alludes to the fact that even firms in the two countries that do not previously have policies on environmental protection and intends to have one in the nearest future favors policies that concerns liquid, solid, and gaseous waste. These forms of waste are evidently the kinds of waste that firms in these two countries mostly generate.

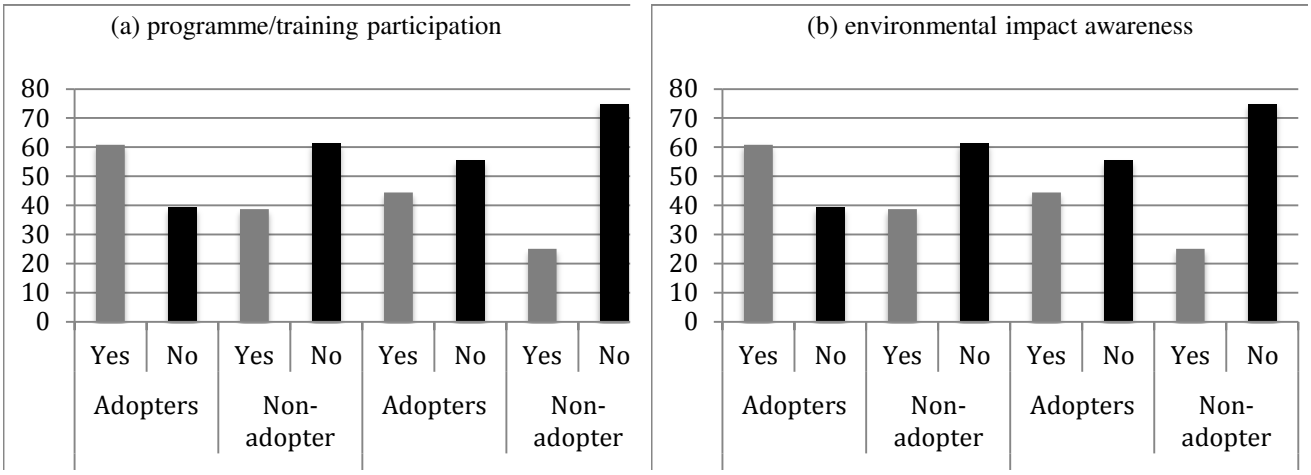
Figure 5: Distribution of Targets of Future Policies on Environmental Protection for Firms that do not Currently Have but plans to have in Future



We further inquire from the small businesses whether they are aware that their production activities have a direct impact on the environment in which they operate. We also investigate whether any worker in the firm has participated in programmes or trainings on issues relating to environmental pollution. The responses (presented in Figures6a and 6b) show that 61 and 67 percent of the small businesses that have policies on environmental protection have previously been to trainings and programmes on environmental pollution, and are aware that their production activities have a direct impact on the environment. Only 39 percent of firms in Nigeria who do not have policies on environmental protection have been previously engaged in such trainings and programmes, while 51 percent of the same groups of firms are aware that their production activities have a direct impact on the environment. This statistics shows that in Nigeria, most firms are aware of the effect of their activities on the environment, but this form of awareness does not translate to steps on how to curtail these impacts.

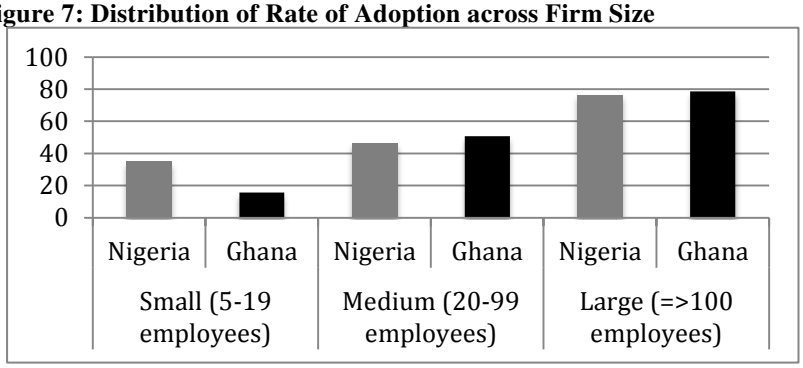
Compared to the distribution in Nigeria, a somewhat different observation is seen in Ghana. Most firms that already have environmental protection policies were previous participants of trainings and programmes on environmental pollution. Similarly, about 51 percent of firms that previously do not have environmental protection policies claimed they had attended some form of training on environmental pollution. Also, 78 percent of firms with environmental protection policies are aware that their activities can have an adverse impact on the environment. This means that training may be more important in enhancing firm's adoption of policies on environmental protection.

Figure 6: Programme/Training Participation and Environmental Impact Awareness



Finally, we compare the extent of adopting policies on environmental pollution across a specific firm characteristic – i.e. the firm size, which is measured by number of employees. The statistics across country are presented in Figure 7. It is evident from the Figure that the rate of adoption of environmental protection policy is higher among the large-scale firms in both countries. This distribution could be due to the fact that these categories of firms have higher social reputation to maintain, are more economically capable to implement such policies, or/and their activities may be more monitored by regulatory agencies.

Figure 7: Distribution of Rate of Adoption across Firm Size



Regression estimates - Matching Estimations

We present the PSM results to understand the impact of small business adoption of policies that protects the environment on performance. For this estimation we combine the data for both countries and then control for country effect in the observable characteristics. The summary statistics of the observable characteristics for small businesses that have adopted the policy and those that have not is presented in Table 2 to check the extent of difference in the observable characteristics across the

two groups. From the Table, there is no significant difference in the sectorial composition of the small businesses and the experience of their top managers, while other characteristics like the top managers educational status, knowledge of green industrialization and environmental protection, training experience on environmental protection, internet usage, and the extent of innovation record significant differences across the two groups.

The point to note from the summary statistics presented in Table 2 is that there are obvious significant differences in the observable characteristics across firms in the two groups. This shows that firms in the two groups are not alike, and for a matching process to be efficient, these significant differences must be reduced such that there can be appropriate counterfactual found from the comparison group for those firms who have adopted the environmental protection policy. Therefore the propensity score matching technique is estimated to reduce these significant differences by deriving the propensity scores from the logistic regression, and ensuring that these scores are well balanced.

Table 2: Summary Statistics and Test of Significant Differences

Variable	Total (842)		Adopters (624)		Comparison (209)		$t/_{x^2}$
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
Observable Characteristics							
Country (1, Nigeria; 2, Ghana)	1.47	0.50	1.32	0.47	1.52	0.50	5.00***
Sector (1 if manufacturing)	0.68	0.45	0.70	0.46	0.68	0.47	-0.68
Top managers education (1 if >=University)	0.54	0.50	0.78	0.41	0.46	0.49	-8.36***
Top managers experience (# years)	14.06	10.30	14.35	9.85	14.02	10.45	-0.38
Firm GI knowledge (0, low to 8, high)	2.92	2.33	3.63	2.53	2.66	2.20	-5.14***
Firm trained on environmental protection (1 if yes)	0.40	0.49	0.69	0.46	0.30	0.46	-10.70***
Internet use (1 if yes)	0.50	0.50	0.72	0.45	0.43	0.49	-7.56***
Innovation (0, low to 10, high)	3.09	2.35	3.90	2.27	2.82	2.31	-5.75***
Outcome Variables							
Firm performance (000, 000 USD)	6.23	9.60	30.1	21.30	1.88	1.89	-2.63**
Labour productivity (total sales/ labour)	11925	135,755	51,948	296,291	1515	7602	-3.15***

Note: Variables like trade union association and the size of the business wasnot included because it these variables causes the balancing property of the model not to be satisfied. However, we included the size variable in the robustness check with a different specification. The superscript *, **, *** imply 10, 5 and 1 percent levels of significance.

The result of the logistic regression is presented in Table 3. From the Table, the observable characteristics that significantly explain the adoption of environmental protection policy include top managers' educational attainment, top managers' experience in the particular sector, knowledge and training about environmental protection and pollution, and the innovative capacity of these small businesses. Evidently, the statistics from the Table show that firms that have had exposure to training on environmental protection, and whose top managers have University degrees and other forms of post-graduate education are more likely to have environmental protection policies. This finding aligns with our earlier submission that training is an important element to drive firms willingness to adopt environmental protection policies. Also, the education of the top managers is another important variable. Other observable characteristics like the sector of the firm, country of operation, and the firm's Internet usage do not significantly explain the likelihood of adopting environmental protection policy.

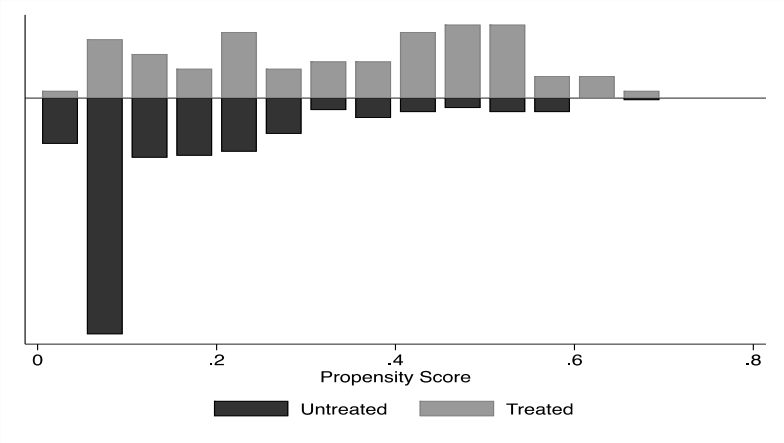
Table 3: Logistic Regression

Dependent variable: Adoption of environmental protection policy	Coefficient,	(P.value)
Country (1, Nigeria; 2, Ghana)	-0.117	(0.391)
Sector (1 if manufacturing)	0.065	(0.592)
Top managers education (1 if *x*>=University)	0.319**	(0.023)
Top managers experience (# years)	0.065**	(0.039)
Firm GI knowledge (0, low to 8, high)	0.053**	(0.050)
Firm trained on environmental protection (1 if yes)	0.796***	(0.000)
Internet use (1 if yes)	0.074	(0.570)
Innovation (0, low to 10, high)	0.052*	(0.053)
Constant	-1.556***	(0.000)
Pseudo R^2		0.157
		121.83
LR Chi2		(0.000)
Log likelihood		-325.989

Note: The value in parenthesis is the probability value of the wald test. The superscript *, **, and *** imply significant levels at 10, 5 and 1 percent, respectively.

The next check is the balancing of the propensity scores from the logistic regression, as this shows the extent to which the differences across the two groups of small businesses are reduced to efficiently identify a valid counterfactual. Figure 8 shows the histograms of the predicted propensity scores for the two groups of small businesses. From the Figure, those small businesses that have adopted this policy have equivalent matches from those in the comparison group. The histogram is fairly similar, which suggest that there is an overlap and similarity between the propensity scores of the two groups of firms.

Figure 8: Propensity Score Distribution



To corroborate the outlook in Figure 8, Table 4 is a further check for the matching quality by comparing the differences between the two groups of firms, in terms of the overall covariance distribution (mean and median absolute bias) and the model fit (pseudo R2 and LR-test) before and after the matching. The results for the Nearest Neighbor Matching (NNM), Kennel Matching (KM), and the Radius Matching (RM) technique in Table 4 suggest that the pre-matching differences in the observable characteristics across the two groups of small businesses are significantly reduced after the matching. For instance, the mean absolute biases are significantly reduced for the three matching algorithms, and the p-values of the Likelihood Ration (LR) test are no longer significant for post-matching. The mean and median differences are also significantly reduced after the matching process.

Table 4: Matching Quality Checks

Matching Algorithms	Outcome	Sample	Pseudo R2	LR chi2	p> Chi2	Mean Bias	Median Bias
5 Nearest Neighbour Matching (NNM)	Firm performance	Unmatched	0.213	80.910	0.000	55.400	50.900
		Matched	0.041	8.820	0.358	15.200	15.900
	Firm productivity	Unmatched	0.204	79.250	0.000	54.000	49.200
		Matched	0.040	8.910	0.351	15.300	15.800
Kernel Matching (KM)	Firm performance	Unmatched	0.213	81.760	0.000	55.300	50.000
		Matched	0.044	9.620	0.293	16.700	16.600
	Firm productivity	Unmatched	0.204	79.250	0.000	54.000	49.200
		Matched	0.042	9.410	0.309	15.700	15.200
Radius Matching	Firm performance	Unmatched	0.213	81.760	0.000	55.300	50.000
		Matched	0.046	9.970	0.267	17.800	15.200
	Firm productivity	Unmatched	0.204	79.250	0.000	54.000	49.200
		Matched	0.043	9.630	0.292	16.600	13.300

Average Difference between Firms in the Two Groups

Having confirmed the efficiency of the matching process, we consider the next estimation that shows the impact of adopting policies on environmental protection on the performance of small businesses. The estimates of this regression are presented in Table 5. As shown in the Table, having policies on environmental protection does have a significant impact on the profit of small businesses. The estimates from the NNM, KM, and RM are approximately 100, 79, and 81 percent, respectively. Implying that small businesses with such policies are more profitable than their counterparts by the mentioned range. The significance of these increases varies across the matching algorithms; however, they are within the range of 1 and 10 percent levels of significance. The OLS estimate and the nearest-neighbourhood with bias-corrected estimators also corroborates the earlier findings.

We find mixed evidence for the productivity of the small businesses. From Table 5, we find significant impact for some matching algorithm such as the KM technique, but we do not find the same results for the NNM and RM algorithms. The OLS estimations show a 10 percent significant level of impact, while the bias-corrected estimation still shows insignificant relationship. Based on these results, it is deduced that despite adopting environmental protection policies has a positive impact on the productivity of small businesses in Nigeria and Ghana, the significance of this relationship is not consistent across the matching algorithms.

Table 5: Estimated Average Treatment Effect

	OLS	NNM	KM	RM	Bias - corrected
Firm performance	1.821***	1.030**	0.788***	0.806*	0.646**
	(0.000)	(0.035)	(0.000)	(0.062)	(0.029)
Firm productivity	50,433.52*	53388.7	54,492**	54,006.7	55,457
	(0.100)	(0.128)	(0.010)	(0.130)	(0.209)

Note: Probability values are in parenthesis. The superscripts *, ** and *** imply significant levels at 10, 5 and 1 percent, respectively. The performance variable was logged. A 300 bootstrap replication were used for each of the algorithms (i.e. NNM, KM, and RM). Following the Rosenbaum-bound tests, these outcomes are not sensitive to hidden biases.

Robust Checks

As earlier indicated, some robustness checks were performed on the results, including adjusting some key parameters, which are as follows;(i)re-estimate the propensity scores using different specifications that includes the measure of the size of the small businesses, extent of energy generation using generator/diesel, listing status of the firm, previous implementation of environmental pollution policy in last five years,

and cost of implementing such policies; (ii) re-estimate the propensity scores without using some variables that were found not to be significant in the earlier model (e.g. country, sector, and Internet use).

The results of the robustness checks are in Table 6. The result shows that the estimates are consistent with those in Table 5. For instance, despite using different specifications including the size of the firm in re-estimating the PSM and dropping some variables that are not significant in the earlier logistic regression, the results still maintains that small businesses with policies on environmental protection perform better than the comparison. We found the result for the productivity of these small businesses to still be positive. Though the mean and median absolute bias were significantly reduced after the matching process used to generate the estimates in Table 6, we see that the bias remains slightly high for the first check, which precludes us relying on the first check for a clear conclusion on the robustness of our findings. Hence, we further present the instrumental variable regression in Table A1 in the appendix.

Table 6: Robustness Checks

	Outcomes	Firm performance	Firm productivity	Mean bias	Median bias
Using different specifications	NNM	1.165** (0.019)	54205.460** (0.021)	39.000	42.200
	KM	1.462** (0.018)	53959.250** (0.021)	37.300	33.700
	RM	1.364** (0.018)	53959.250** (0.026)	37.800	33.900
Without using some variables	NNM	1.350*** (0.005)	56020.37** (0.011)	12.300	7.600
	KM	1.407*** (0.002)	55827.63* (0.094)	13.400	4.300
	RM	1.524*** (0.000)	55768.84** (0.012)	13.400	4.300

Note: Probability values are in parenthesis. The superscripts *, ** and *** imply significant levels at 10, 5 and 1 percent, respectively. The performance variable was logged. A 300 bootstrap replication were used for each of the algorithms (i.e. NNM, KM, and RM).

The instrumental variable regression in Table A1 includes covariates like the capital input of the small businesses (i.e. assets[8], and labour input), and innovation (De Rosa *et al*, 2015; Bai *et al*, 2016; Efobi and Orkoh, 2018) following a simple production function. The endogeneity concerns we earlier mentioned in section 3werechecked with the null hypothesis that firm adoption of environmental protection policy is

[8]This was underreported in the survey, as respondents were unwilling to disclose this value.

indeed exogenous. The test results, reported at the lower section of Table A1 (in the appendix) fail to reject the null hypothesis that the policy adoption is exogenous, suggesting the importance of accounting for endogeneity concerns in our estimations. Also, although not reported, the first stage regression shows that the selected instruments significantly explain this variable, and the over-identification test further supports the validity of the chosen instruments.

From the instrumental variable regression we find a higher positive effect for the main variable of interest. This positive and significant effect from the instrumental variable regression further substantiate the positive impact that adopting environmental protection policies have on firm performance and productivity. Although the impact is way beyond the range for the PSM, which is expected considering the different estimation techniques, the positive impact reverberates our earlier findings.

5. Discussion

Our major finding in relation to small business adoption of environmental protection policies and performance in Nigeria and Ghana is that adopting these policies play some crucial roles in the outcome of these businesses. The impact is seen for performance of the small businesses, but it is not clear for productivity in the main regression. We latter finds consistent positive and significant estimates for productivity in the robust checks. These results are logical with an explanation that adopting these policies exposes these businesses to different dynamic economic experiences. First, small businesses gain social acceptance by potential customers and the broader stakeholder when they engage in actions that show that they care about the environment. Such acceptance will have a positive impact on the sales volume and performance of such businesses, considering that existing and potential customers will value the existence of the business and patronize their goods or services. There are instances in these two countries where small businesses that support social work experienced significant patronage by low and middle income customers who were acquainted to the business following their active role in the broader social development of their community (see Aliyu and Noor, 2015; Famiyeh, 2017).

Second, small businesses who are engaging in pollution and poor waste management

are the most vulnerable to government fines, harassment from public agencies whose responsibility are to enforce environmental protection policies, unwarranted office closure by government agency to intimidate these businesses to engage in informal payments to corrupt public officials in order to avoid fines and fees, and even violent and non-violent protests by community members. These occurrences can be economically burdensome on the small businesses and can affect their overall profit and productivity through dispute settlement cost, litigation cost, and other payments that are made to legitimate and corrupt officials to avoid distortions in business operations. In essence, many communities in Nigeria and Ghana see firm involvement in environmental protection as a social contract, whereby businesses that engage in such actions are either exempted from unnecessary harassment by members of the community, or are favorably treated by public officials knowing that they have the allegiance of the broader society. The performance and productivity of small businesses that engage these policies will therefore be affected because they will be exempted from these additional costs.

The findings from this paper are also consistent with the literature that shows that firms consciousness of the environment have a direct impact on their performance. See for instance studies like Earnhart and Lizal (2010), Qi *et al* (2014), Manrique and Marti-Ballester (2017) who all find a positive effect on performance from engaging in actions that considers environmental protection. Our findings can therefore be an important first step in encouraging firms to consider environmental issues in their policy formulation knowing that such action affects their performance. This is important for low-income countries like Nigeria and Ghana that have lax regulatory and enforcement framework to protect the environment in the light of growing industrial activities.

The broader implication of our result is that the industrial sector is an important player in driving environmental management given that it is a major source of pollution and also a major user of fossil fuel energy resources (for instance) in production (OECD, 2001). Industrial production should become more efficient in resource allocation and be environmentally friendly, thus being instrumental in reconciling rapid economic growth with greater economic sustainability in a manner

that emphasizes green industrialization (Hallegatte, Fay and Vogt-Schilb, 2013). Small businesses specifically have a major role to play in accelerating the transition to sustainable development through the adoption of climate-safe and clean technology in their production and operation structure (World Bank, 2014) considering that they are densely present in these countries.

6. Conclusion

In this paper we assessed the extent of environmental protection effort of small businesses, and its impact on their performance using a unique dataset from a firm-level survey in 2017 for Nigeria and Ghana. Our results suggest that the extent of small business adoption of policies that protect the environment is low in both countries. We also find that more small businesses with such policies in Nigeria consider solid and liquid waste management as important pollution to confront, while they largely focus on gaseous and solid waste in Ghana. Another important observation from the descriptive analysis is that the size and the level of education of the manager of these small businesses matter for the adoption of environmental protection policies. In terms of impact, small businesses with environmental protection policies tend to perform better than they would assume they never had such policies. Considering firms' productivity, however, the significant effect is murky.

This paper contributes to the literature on the sustainable industrialization for small businesses in developing countries. In a unison perspective, environmental pollution is viewed as a potential threat to human existence, and the effective development of the society and the entire ecosystem. The asymmetric pattern revealed in the measures of the performance of firms as a result of environmental protection policies reveals potentials for advocacy for the need for small businesses to engage such actions that protect the environment.

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APPENDIX

Table A1: Instrumental Variable Regression

Outcomes	Firm performance		Firm productivity	
	1(a)	1(b)	2(a)	2(b)
Policy adoption	6.404*** (0.000)	6.587** (0.021)	50,524.400* (0.100)	54,077.760* (0.000)
Covariates	No	Yes	No	Yes
Constant	5.818** (0.000)	7.051*** (0.000)	66,623.030 (0.134)	14,278.290** (0.045)
R-squared	0.1950	0.263	0.1860	0.210
Endog. Test [Wu-Hausman] - p-value	(0.000)	(0.000)	(0.031)	(0.026)
Endog. Test [Durbin - Chi2] - p-value	(0.000)	(0.000)	(0.031)	(0.030)
Overid. Test (p-value)	(0.356)	(0.379)	(0.382)	(0.455)

Notes: Covariates used in Columns 1a and 1b, and 2a and 2b are (assets, labour, and innovation). The instruments used for the analysis are: (i) a dummy variable capturing the influence of government pressure in setting up environmental protection policies; (ii) the influence of customer/suppliers demands on firm for environmental protection. The superscripts '***' indicates significant at 1 percent; '**' indicates significant at 5 per cent; and '***' indicates significant at 10 per cent.