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# Spatial proximity and firm performance: evidence from non-farm rural enterprises in Ethiopia and Nigeria

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**ABSTRACT**

Spatial proximity and firm performance: evidence from non-farm rural enterprises in Ethiopia and Nigeria. *Regional Studies*. The productivity of non-farm enterprises in rural Africa can be associated with the productivity of other spatially proximate non-farm enterprises. To test for the presence and significance of such spatial autocorrelation, the article uses data from the georeferenced 2011 Ethiopian Rural Socioeconomic Survey (ERSS) and the 2010/2011 Nigeria General Household Survey (NGHS), and employs exploratory spatial data analyses. There is evidence of significant spatial clustering of firm performance in both countries. This spatial dependence is empirically modelled using average distance measures between firms. It is found that in addition to other household, firm and community characteristics, spatial proximity between firms plays an important role in explaining firm productivity in Nigeria and Ethiopia.

**KEYWORDS**

entrepreneurship; Africa; rural development; agriculture; firm proximity and spatial autocorrelation; Ethiopia; Nigeria

摘要

空间邻近性和企业绩效：来自埃赛俄比亚和尼日利亚的非农业乡村企业的证据. *Regional Studies*. 非洲乡村的非农业企业之生产力，与其他空间邻近的非农业企业的生产力相关。为了检测此般空间自相关的存在与显着性，本文运用具有地理坐标参照的2011年埃赛俄比亚乡村社会经济调查（ERSS）与2010/2011年尼日利亚家户普查（NGHS）的数据，并使用探索性空间数据分析。在两个国家中，皆有企业绩效的显着空间集群之证据。本研究运用企业间的平均距离方法，在经验上对此般空间依赖进行模式化。研究结果发现，除了其他家户、企业与社群特徵之外，企业间的空间邻近性，对于解释尼日利亚和埃赛俄比亚的企业生产力而言，亦扮演着重要的角色。

关键词

创业精神; 非洲; 乡村发展; 农业; 企业邻近性和空间自相关; 埃赛俄比亚; 尼日利亚

**RÉSUMÉ**

La proximité spatiale et la performance des entreprises: des résultats provenant des entreprises du secteur non agricole situées en milieu rural en Éthiopie et en Nigérie. *Regional Studies*. On peut associer la productivité des entreprises du secteur non agricole situées en milieu rural en Afrique à la productivité des autres entreprises non agricoles situées à proximité. Afin de déterminer la présence et l'importance d'une telle aurocorrélation, l'article emploie des données provenant de la Ethiopian Rural Socioeconomic Survey (ERSS) 2011 (enquête socioéconomique rurale éthiopienne menée en 2011) et la Nigeria General Household Survey (NGHS) 2010/2011 (enquête générale auprès des ménages nigériens menée entre 2010 et 2011) et emploie une analyse exploratoire de données spatiales. Il s'avère des preuves d'un important regroupement spatial de la performance des entreprises dans les deux pays. À partir des mesures de la distance moyenne d'une entreprise à une autre, on modélise cette dépendance spatiale empiriquement. Il s'avère que, en plus des autres caractéristiques des ménages, des entreprises et des collectivités, la proximité spatiale des entreprises explique dans une grande mesure la productivité des entreprises situées en Nigérie et en Éthiopie.

**MOTS-CLÉS**

esprit d'entreprise; Afrique; aménagement rural; agriculture; proximité d'entreprise et autocorrélation spatiale; Éthiopie; Nigérie

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**ZUSAMMENFASSUNG**

Räumliche Nähe und Firmenleistung: Belege aus nicht-landwirtschaftlichen Betrieben in ländlichen Gebieten von Äthiopien und Nigeria. *Regional Studies*. Die Produktivität von nicht-landwirtschaftlichen Betrieben in ländlichen Gebieten Afrikas lässt sich in einen Zusammenhang mit der Produktivität von anderen, räumlich nahen nicht-landwirtschaftlichen Betrieben bringen. In diesem Artikel wird die Präsenz und Signifikanz einer solchen räumlichen Autokorrelation mithilfe von Daten des georeferenzierten Ethiopian Rural Socioeconomic Survey (ERSS) von 2011 sowie des Nigeria General Household Survey (NGHS) von 2010/2011 unter Einsatz von exploratorischen räumlichen Datenanalysen überprüft. In beiden Ländern gibt es Anzeichen für eine signifikante räumliche Ballung der Firmenleistung. Diese räumliche Dependenz wird unter Verwendung von Durchschnittsmaßen für die Entfernungen zwischen den Firmen auf empirische Weise modelliert. Es zeigt sich, dass die räumliche Nähe zwischen Firmen zusätzlich zu anderen Merkmalen der Haushalte, Firmen und Gesellschaft eine wichtige Rolle für die Erklärung der Produktivität von Firmen in Nigeria und Äthiopien spielt.

**SCHLÜSSELWÖRTER**

unternehmertum; Afrika; ländliche entwicklung; landwirtschaft; firmennähe und räumliche autokorrelation; Äthiopien; Nigeria

**RESUMEN**

Proximidad espacial y rendimiento empresarial: evidencia de empresas rurales no agrícolas en Etiopía y Nigeria. *Regional Studies*. La productividad de empresas no agrícolas en zonas rurales de África se puede vincular a la productividad de otras empresas no agrícolas espacialmente próximas. En este artículo comprobamos la presencia e importancia de esta autocorrelación espacial mediante datos de la encuesta georeferenciada Ethiopian Rural Socioeconomic Survey (ERSS) de 2011 y la Nigeria General Household Survey (NGHS) de 2010/2011, y empleamos análisis de datos espaciales exploratorios. En ambos países hay indicios de una aglomeración espacial significativa del rendimiento empresarial. Esta dependencia espacial se modela empíricamente mediante medidas de distancias medias entre las empresas. Observamos que además de otras características de hogares, empresas y comunidades, la proximidad espacial entre las empresas desempeña un importante papel a la hora de explicar la productividad de las empresas en Nigeria y Etiopía.

**PALABRAS CLAVES**

espíritu empresarial; África; desarrollo rural; Agricultura; proximidad empresarial y autocorrelación espacial; Etiopía; Nigeria

**JEL** C21, L25, M13, O55

**HISTORY** Received November 2014; in revised form November 2015

## INTRODUCTION

Non-farm enterprises[1] are ubiquitous in rural Africa. Around 42% of rural households in a recent survey in Africa operated non-farm enterprises (Nagler & Naudé, 2014a), and between 40% and 50% of rural household income in Africa is estimated to be from rural non-farm enterprises (Haggblade, Hazell, & Reardon, 2010; Rijkers & Costa, 2012). Growth in rural populations, declines in agricultural employment and rising demand for higher-value added farm products amongst a rising middle class in Africa are making the non-farm economy increasingly vital for job creation, livelihoods and stability (De Brauw, Mueller, & Lim Lee, 2014; Janvry & Sadoulet, 2010; Rijkers & Costa, 2012).

Despite this, there are glaring gaps in the scholarly literature on these rural non-farm enterprises. Scholars have studied the push and pull factors that determine whether and when rural households start non-farm enterprises (e.g., Nagler & Naudé, 2014a; Reardon, Berdegue, Barrett, & Stamoulis, 2006; Rijkers & Söderbom, 2013). They have also attained a fairly good grasp on the impact of non-farm enterprises on rural poverty and employment (e.g., Barrett, Reardon, & Webb, 2001; Fox & Sohnesen, 2013). The gap, however, is on the performance of non-farm enterprises in Africa (Rijkers, Soderbom, & Loening, 2010). The literature has so far very little to say on potentially important aspects of non-farm enterprises, such as how productive they are, or what the factors are that determine their productivity and survival (Liedholm, 2007). Apart from Nagler and Naudé (2014b), to the best of their knowledge the present authors are not aware of any previously published study in Africa that satisfactorily contributes to knowledge in this regard (the closest being, perhaps, Rijkers et al., 2010). This is a serious omission: if the survival, growth and job creation of non-farm enterprises depend on their performance, then a rigorous understanding in this regard will have potentially important policy implications.

The present paper makes a modest contribution toward filling this knowledge gap by providing empirical evidence on the productivity of rural non-farm enterprises in Ethiopia and Nigeria. Moreover, it includes a measure for spatial proximity as a potential explanatory factor of firm performance. To the best of the authors' knowledge, this is the first time this has been done in the context of rural household enterprises in Africa. This allows one to take into consideration the fact that patterns of non-farm productivity may be affected by neighbouring firms' productivities. Where spatial effects are present, the implication is that empirical analyses that do not explicitly model the spatial

relationship, even when the main interest is not on spillover per se, may yield biased estimates of firm performance (Anselin & Griffith, 1988), especially in the developing country context. The exploratory spatial data analyses (ESDA), which take into account the spatial nature of the data and present visual information on the presence of spatial effects, employ geographical information system (GIS) information at the enumeration area (EA) level, while the empirical analysis is performed using distance variables at the household/firm level.

The paper is structured as follows. The second section summarizes the relevant literature. The third section outlines the data and provides an exploratory analysis of the spatial patterns of rural non-farm and farming activities in Ethiopia and Nigeria. The regression estimation strategy and results are presented and discussed in the fourth section. The fifth section concludes.

## RELEVANT LITERATURE

In the literature on firm performance in developing countries, and specifically Africa, most of the attention has been on measures of firm sales and employment growth (e.g., Nichter & Goldmark, 2009). Relatively fewer studies have dealt with productivity as a measure of performance. Productivity is, however, one of the most important measures of performance as it reflects how efficiently the firm turns inputs into outputs. The most commonly used measures are total factor productivity (TFP) and partial measures such as output or revenue per worker. As Nagler and Naudé (2014b) also mention, the patterns and determinants of firm-level productivity have generated a large literature, mainly using data from advanced economies. A recent survey is provided by Syverson (2011). In this literature, the interest on the productivity of firms is based on the realization that more productive firms are more likely to survive and to grow, create jobs and innovate (e.g., see also Wennberg & Lindqvist, 2010). In Africa, Frazer (2005) found evidence from Ghanaian manufacturing enterprises that more productive enterprises are less likely to fail.

Productivity levels are, however, widely dispersed across firms (Nagler and Naudé, 2014b)[2] and this has begged the question why. Key determinants that have been identified include managerial competence (Bloom & Van Reenen, 2010, Mano, Iddrisu, Yoshino, & Sonobe, 2012); the skills and education of an enterprise's workers (Moretti, 2004); innovation and use of technology (Bernard, Redding, & Schott, 2010); experience and learning by doing (Van Biesebroeck, 2005); and external shocks (Rijkers & Söderbom, 2013).

Productivity levels are also widely dispersed across space. This reflects the fact that the productivity of a firm also depends on the productivity of other firms in close proximity – distance and clustering matters. One reason is that 'knowledge spills over quickly' (Mano et al., 2012, p. 466). Similarly, productive firms tend to cluster together not only due to fewer productive firms benefitting from localization economies such as the spilling over of knowledge and technology (Bloom, Schankerman, & Van Reenen, 2013; Martin, Mayer, & Mayneris, 2011) and from horizontal linkages (Nichter & Goldmark, 2009) but also because the competitiveness of highly productive firms tends to push less productive firms in the same industry out of the market (Ali & Peerlings, 2011; Foster, Haltiwanger, & Syverson, 2008).

The spatial clustering of firms, and the agglomeration benefits it confers on them, has long been studied in regional science and in geographical economics (e.g., Fujita, Krugman, & Venables, 1999), wherein the clustering of many firms in close geographic proximity generated localization and urbanization economies (Martin et al., 2011). The former is associated with labour-market pooling, and knowledge spillover effects within specific industries, and the latter with the benefits of a diverse and more competitive business environment and more support services. The vast bulk of studies in this regard has been dealing with advanced economies, and has found spatial autocorrelation significant and attached much value to the clustering of firms in geographic space.

For example, Wennberg and Lindqvist (2010) studied 4397 Swedish firms and found that firms that are located in stronger clusters are more likely to survive, and additionally create more jobs and pay their workers higher wages. Rupasingha and Contreras (2010) studied the determinants of regional variation in microenterprises in rural areas using county-level information on the United States and used spatial lag and error model specifications to control for the observed spatial dependence in the data. They argued that the significant spatial parameters observed are indicative of spillover effects in the data. Baumgartner, Schulz, and Seidl (2013) used a spatial random effects model to find evidence of spatial spillover effects on local entrepreneurial activities in rural Switzerland. Martin et al. (2011) used a panel dataset of French firms and found evidence that spatial spillover effects are significant, and that clustering increases firms' productivity, mainly due to localization economies. Deller (2010) employed a geographical weighted regression (GWR) to examine whether the role of microenterprises in economic growth varies over space in the United States. The advantage of the GWR technique is that instead of the traditional assumption that a variable has the same influence over all locations, this method of spatial enquiry allows the explanatory variables to have differential effects across geographical space. Deller found that although microenterprises have a positive role in explaining growth in the eastern and central regions of the United States, they have a dampening effect in the Coastal Pacific regions.

Despite the varied empirical techniques employed in the above-mentioned studies, they have concurred that spatial effects *do* appear to matter for enterprise performance and growth (in developed countries). As mentioned above, fewer spatial studies of rural non-farm enterprise creation and performance have been conducted in developing countries, and even fewer in Sub-Saharan Africa. This is despite the fact that in developing countries the importance of clustering and spatial proximity for firm performance has been acknowledged. The study by Gibson, Kim, and Olivia (2011) explicitly accounted for spatial effects among non-farm enterprises in

Indonesia and found that firm's performance to a large extent is determined by proximity with other firms. Johny, Wichmann, and Swallow (2014) also illustrated the importance of social networks of households for rural income diversification in India.

In Africa, for instance, McCormick (1999, p. 1532) has argued that spatial proximity between firms in Africa would have positive impacts on their productivity due to 'poor infrastructure, weak information systems, and cultures that place high value on face-to-face communication'. And according to Siba, Söderbom, Bigsten, and Gebreeyesus (2012, p. 2) 'spillovers and other externalities may have large effects on firm performance in this environment, since most firms operate far away from the best practice frontier, implying considerable scope for learning'. Consistent with the aforementioned, Ali and Peerlings (2011) found evidence from the handloom industry in Ethiopia that clustering can help microenterprises to improve their productivity. Ayele et al. (2009) examined the importance of clustering in the rural non-farm sector in Ethiopia, and its impact on productivity. Without explicitly employing spatial econometric techniques, they investigated the presence of spillover effects among a concentration of handloom weavers in the country and found that clustering helps to improve productivity through shared workspaces, for instance, especially in the absence of adequate financial resources. Siba et al. (2012), also using data from Ethiopia, found that spatial proximity of enterprises to other enterprises in the same industry improves their productivity, and reduces the price of their products. Their results imply that Ethiopian clusters did not form endogenously because enterprises would like to avoid the price-reducing effects of competition from similar firms.

Despite the recognition of the importance of spatial clustering and spatial autocorrelation for the productivity of firms in Africa, relatively few studies have examined the nature and importance of spatial spillover effects on firms, and none of which the authors are aware of has yet examined the productivity of non-farm enterprises including the potential for spillover effects due to firm productivity. As mentioned in the introduction, the prior study that comes closest to this is Rijkers et al. (2010), who studied the performance of non-farm manufacturing enterprises in rural Ethiopia and compared their performance with than of urban manufacturing enterprises. They found that enterprise productivity is more dispersed in rural than in urban Ethiopia, and that urban enterprises are more productive than rural enterprises. For instance, using output per labour as a productivity measure, they calculated an output-to-labour ratio for enterprises in remote rural areas as 0.43, in rural towns as 0.95 and in urban areas as 2.30 (Rijkers et al., 2010, p. 1282). They concluded that proximity matters for enterprise productivity, and implied that spatial spillover effects may be important, concluding that for rural enterprises 'even limited interaction is likely to lead to substantial increases in efficiency' (p. 1291).

This paper builds on this research in a number of ways: firm performance is examined in two rural settings in Eastern and Western Africa, with controls for firm heterogeneity in performance. Importantly, a direct test for the presence of spatial effects is provided by performing exploratory spatial data analysis that presents visual data on spatial clustering of firms' performance in Ethiopia and Nigeria. Finally, it explicitly models the spatial information in the data and examines how firm proximity contributes to performance.

## Spatial proximity, clustering and effects on firm performance

Firms that engage in similar types of activities may benefit from nearness to each other for a number of reasons such as the development of an experienced pool of workers, better access to markets and suppliers, and easy knowledge and information flows (Marshall, 1920) between firms. Given its non-excludable and non-rivalrous nature, knowledge created may not remain within a firm but spreads to neighbouring firms within the community, leading to positive effects on firm performance. Firm performance may, however, be negatively affected if firms become too introverted and therefore do not benefit from additional technical knowledge from outside sources.

Industry spillovers through the presence of productivity-enhancing tools may often also be beneficial to firms. These tools may include technological advancements, beneficial management practices, labour force skills training, among others, and may be transferred through input–output relationships and inter-industry linkages. Industry spillovers may confer negative benefits on firms and inversely affect performance if there is increased competition among firms that leads to price decreases. While different firms from various industries may benefit from each other through the spread of ideas and innovations that may result from technology linkages between related industries, firm productivity may be negatively affected if the sectors/industries are too fragmented, leading to poorly targeted infrastructure, specialized structures and business policies.

The presence of growth spillovers may also explain spatial clustering of firms and contribute to better firm performance within the cluster. Firms that perform well may become better-off and therefore able to increase their general demand for goods and services within the communities, including the demand for other firms' output. It is important to note, however, that here also some negative effects may prevail. Increased firm performance may increase congestion costs relating to the use of infrastructure and the availability of labour and other inputs.

According to Sonobe and Otsuka (2011), these various agglomeration economies (i.e., information spillovers, labour training and access to supplies) are closely related to each other. For example, information and knowledge spillovers may be obtained from the movement of human resources between firms, and from linkages between firms. The research makes the point that firms within communities are likely to benefit positively from close proximity to each other, either through knowledge or growth spillovers, given the communal nature of household system in developing countries. Control for a host of other potential explanatory factors for both Ethiopia and Nigeria are

included in the study, which illustrate differences in the determinants of firm productivity between both countries. A limitation of the data is the inability to determine exactly how these spillovers occur. This paper shows, nonetheless, that space plays a very important role in the performance of non-farm enterprises in Ethiopia and Nigeria.

## DATA AND METHODS

### Data

The paper uses data from the 2011 Ethiopian Rural Socio-economic Survey (ERSS) and the 2010/11 Nigeria General Household Survey (NGHS). About 83% of Ethiopia's population is rural (ESSP-II, 2009). In addition to information on basic demographics such as education, health, labour, time use and non-farm economic activities, the data also include geographical information at the EA level, which facilitates spatial data analyses. To measure rural non-farm enterprise performance the paper uses the enterprise output per worker. This is a commonly used measure of productivity, although it must be recognized that it is a partial measure and not ideal (Syverson, 2011). The paper therefore also employs value added as a second measure of firms' performance.

The ERSS and NGHS also contain community-based information such as social and physical infrastructure. The ERSS sample is representative of rural areas and small towns in Ethiopia. A total of 290 rural areas and 43 small towns were included in the survey, making up a total sample size of 333 enumerator areas available for this research. Each enumerator area is made up of about 12 households. The NGHS is made up of 411 enumerator areas. A total of 1081 households in the Ethiopian dataset are included in the empirical analysis compared with 2133 households in the Nigerian dataset. It is important to state upfront that there may be some issues of selection with this study, as it includes a sample of only households that are engaged in rural enterprises in Nigeria and Ethiopia.

### Descriptive statistics

Basic descriptive statistics are provided in Table 1 for Ethiopia and Nigeria. This includes household-, firm- and community-level variables. In order to examine the performance and productivity of non-farm enterprises in both countries, the sample is restricted to those enumerator areas where rural households are operating non-farm enterprises.

The dependent variable, reflecting rural non-farm enterprise performance and productivity, is measured as the logged value of *total sales of enterprises in the past 12 months per the total number of worker*s – both family and employed workers – in order to control for size effects; and value added, which is derived from the difference between sales and firm costs.[3] Monthly sales and firms' value added measures are 73 027 and 46 552 naira in Nigeria, respectively; and 3633 and 740 birr in Ethiopia, respectively. The average distance between firms within EAs is 1.13 km in Nigeria and 1.18 km in Ethiopia, with large standard deviations, particularly in Nigeria.

The average age of a household head is about 41 years in Ethiopia and about 49 years in Nigeria; and male heads make over three-quarters of the samples in both countries. Older male heads are expected to be associated with higher performing rural non-farm enterprises given that they may be more knowledgeable and experienced. A total of 85% of all household heads (male and female) in the Nigerian sample are married; while about 80% of the sample in Ethiopia report being married. A greater proportion of household heads in Nigeria report that they have had some formal training (i.e., 73%) compared with household heads in Ethiopia (i.e., 47%). Education is typically associated with higher performance in rural non-farm enterprises given that more educated entrepreneurs may be able to employ more efficient techniques of production, and may be aware of, and therefore able to take advantage of, greater opportunities for enterprise improvements such as credit facilities, among others.

In the sample, Muslims make up about one-third of the population in Ethiopia and almost half the sample in Nigeria. The average household size in the sample is about five people in Ethiopia and six in Nigeria.

In terms of community infrastructure, roughly one-third of respondents in both countries have access to phones. A total of 26% of households in the Nigerian sample report that they have a microfinance institution present in the community compared with 36% of the Ethiopian sample.

The average distance to a tarred/asphalt road is about 12 km in Nigeria and about 17 km in Ethiopia. The average distance to the nearest large weekly market is quite similar in both countries – about 67 km. The information on social infrastructure is obtained from the community-level surveys where a reputed member of the society is asked a series of these community-specific questions. The presence of physical infrastructure has been observed to have a positive impact of rural non-farm enterprise performance in other research studies (Gibson & Olivia, 2010). The average annual rainfall in Nigerian sample is 1462 mm, and 1114 mm in the Ethiopian sample. This information is collected at the EA level.

Information is also presented on a number of firm characteristics. Half of all enterprises in the Nigerian sample are located at home compared with 40% of the Ethiopian sample. The remaining enterprises are located at traditional markets, commercial areas, by the roadside, mobile businesses, rivers/lakes/ponds and construction sites. In Nigeria, businesses in the sample were in operation for an average of 6.5 months in the past year. In Ethiopia, 46% of firms in the sample report that the activities of their businesses are seasonal, while the average firm operated for 15 days in a month.

Economic sectors on firm activities are also presented; there are noticeable differences between both country samples. While the manufacturing and construction sector is the most dominant in Ethiopia, the wholesale and retail sector appears to be dominant in Nigeria, with the largest proportion of enterprises. The mining sector is the least popular in both countries, however. Regional/zonal

**Table 1.** Summary statistics (Nigeria and Ethiopia).

| | Nigeria | | Ethiopia | |
|---|---|---|---|---|
| **Variable** | **Mean** | **Standard deviation** | **Mean** | **Standard deviation** |
| *Dependent variables* | | | | |
| Monthly sales[a] | 73,027.32 | 1,501,134 | 3633.47 | 17,573.19 |
| Value added | 46,552.08 | 2,090,557 | 740.699 | 13,734.22 |
| Distance in km (spatial proximity measure) | 1.131 | 12.882 | 1.183 | 2.261 |
| *Household characteristics* | | | | |
| Age of household head | 48.60 | 14.19 | 41.140 | 14.057 |
| Male household head | 0.871 | 0.336 | 0.735 | 0.441 |
| Married household head | 0.848 | 0.359 | 0.798 | 0.402 |
| Educated household head | 0.733 | 0.442 | 0.468 | 0.500 |
| Muslim household head | 0.476 | 0.500 | 0.324 | 0.468 |
| Household size | 5.988 | 3.053 | 4.934 | 2.402 |
| *Community infrastructure* | | | | |
| Access to a phone | 0.361 | 0.480 | 0.397 | 0.489 |
| Presence of a microfinance institution | 0.259 | 0.438 | 0.356 | 0.479 |
| Distance to an asphalt road[b] | 12.338 | 16.470 | 16.954 | 25.554 |
| Distance to market[b] | 66.464 | 44.919 | 67.888 | 49.456 |
| *Firm characteristics* | | | | |
| Home location | 0.512 | 0.500 | 0.402 | 0.491 |
| Months the firm is in operation | 6.532 | 2.583 | – | – |
| Days the firms are in operation | – | – | 15.605 | 9.431 |
| Business is seasonal (dummy) | – | – | 0.460 | 0.499 |
| *Economic sector* | | | | |
| Manufacturing and construction | 0.187 | 0.390 | 0.414 | 0.493 |
| Mining | 0.012 | 0.110 | 0.038 | 0.191 |
| Services | 0.168 | 0.365 | 0.098 | 0.268 |
| Transport | 0.057 | 0.231 | 0.101 | 0.301 |
| Wholesale_Retail | 0.574 | 0.232 | 0.343 | 0.475 |
| *Regions/zones* | | | | |
| North Central | 0.165 | 0.371 | – | – |
| North East | 0.148 | 0.371 | – | – |
| North West | 0.192 | 0.394 | – | – |
| South East | 0.133 | 0.340 | – | – |
| South South | 0.174 | 0.379 | – | – |
| South West | | | | |
| Tigray | 0.189 | 0.392 | 0.089 | 0.285 |
| Afar | – | – | 0.022 | 0.147 |
| Amhara | – | – | 0.187 | 0.390 |
| Oromia | – | – | 0.172 | 0.378 |
| Somalie | – | – | 0.058 | 0.234 |
| Ben_Gumuz | – | – | 0.058 | 0.234 |
| Gambelia | – | – | 0.027 | 0.162 |
| Harari | – | – | 0.043 | 0.204 |

(*Continued*)

**Table 1.** Continued.

| Variable | Nigeria | | Ethiopia | |
|---|---|---|---|---|
| | Mean | Standard deviation | Mean | Standard deviation |
| Diredwa | – | – | 0.060 | 0.238 |
| SNNP | – | – | 0.283 | 0.451 |

Notes: [a]In naira (Nigeria) and birr (Ethiopia).
[b]Kilometres.
SNNP, Southern Nations, Nationalities, and Peoples' Region.

information is also presented and included in the empirical analysis in order to control for regional/zonal variations in enterprise performance.

### Exploratory spatial data analysis

This section presents visual evidence of spatial autocorrelation of firm performance using a variety of exploratory spatial data analysis techniques. The use of quantile maps provides information on the presence of spatial clusters in the data – for instance, are there a number of high- or low-performing firms clustered in space? Global Moran's *I* statistics are used to indicate the presence of positive or negative spatial autocorrelation in the data, and also to determine the magnitude of the observed spatial relationship. Finally, local indicators of spatial dependence provide information on the type and significance of spatial autocorrelation that is present at smaller geographical scales. For detailed information on the techniques adopted and interpretations of findings, see Appendix A in the supplemental data online.

## REGRESSION RESULTS

### Regression results

The dependent variable, rural non-farm enterprise productivity, is regressed on household, firm and community characteristics under two model specifications – firm performance measured as output per worker and performance measured as value added. The results of each of the two model specifications of rural non-farm enterprise performance are depicted in Table 2 for Ethiopia and Nigeria. Errors in the study have been clustered.

Age appears to be negatively correlated with firm performance in both Nigeria and Ethiopia and across all model specifications. This is contrary to expectations as age has been used as a proxy for experience in the literature, and is expected to be positively correlated with enterprise performance (Bregger, 1996; Evans & Leighton, 1989; Frazer, 2005; Rupasingha & Contreras, 2010). Nonetheless, the average age in the sample is quite high (almost 50 years in Nigeria and about 40 years in Ethiopia), creating a situation where individuals may not have the energy to supervise the businesses properly.

In Ethiopia, male household heads appear to be more productive that their female counterparts. Using household heads who have not had any schooling as the base group, education is found to be significantly correlated with rural non-farm enterprise performance in both model specifications in Ethiopia and in the output per worker model specification in Nigeria (Huffman, 1980). The effects of schooling on firm performance in Ethiopia appear to be stronger and more significant than the effects in the Nigerian sample.

Generally, larger household sizes are associated with firm performance in both Ethiopia and Nigeria, with smaller effects observed under the value-added specification in both countries. This may be as a result of household members providing some assistance with the business. It could, however, also be as a result of reverse causality – non-farm enterprises may be set up in response to the demands of larger households.

The effects of the Muslim religion differ for businesses in Ethiopia and Nigeria. In Nigeria, under the value-added approach, Muslim households appear to perform worse than households that belong to other religions. The reverse is true for Ethiopia, however, where under the same model specification, Muslim households perform better than households belonging to other regions. This may be evidence of the importance of religious social capital in rural non-farm enterprise performance and particular specializations in trade among the Muslim population.

With respect to community infrastructure, the presence of a microfinance institution is positively associated with firm productivity in both Nigeria and Ethiopia. This may be as a result of increased access to credit facilities provided by these institutions. However, this finding may also be indicative of reverse causality, where microfinance firms locate themselves in areas where firms are productive. Firms located closer to market places also appear to perform better in Nigeria. This is likely due to the easy access to ready demand for products of these firms.

The importance of the links between non-farm and farming activities has been noted in the literature (e.g., De Janvry, Sadoulet, & Zhu, 2005; Lanjouw & Lanjouw, 2001). Success in agriculture may generate surpluses for investment in off-farm activities, and vice versa, so that one may see a positive correlation between farm and non-farm productivity. Indeed, as Deichmann, Shilpi, and Vakis (2008, p. 1) declared, 'the most predominant view amongst development practitioners about non-farm development is that growth of non-farm activities in rural areas is driven primarily by agriculture productivity growth'. On the other hand, households may engage in non-farm enterprises in response to low agricultural output or limited access to agricultural employment (Hossain, 1988).

**Table 2.** Ordinary least squares (OLS) estimates of rural non-farm enterprise productivity in Ethiopia and Nigeria.

| | Nigeria | | Ethiopia | |
|---|---|---|---|---|
| **Variables** | **Output/worker** | **Value added** | **Output/worker** | **Value added** |
| *Household characteristics* | | | | |
| Age of household head | −0.00494** | −0.00910** | −0.00556+ | −0.00719* |
| | (−1.98) | (−2.22) | (−1.58) | (−1.87) |
| Male household head | 0.189 | 0.176 | 0.269* | 0.379** |
| | (1.27) | (0.70) | (1.84) | (2.24) |
| Married household head | 0.0718 | −0.0299 | −0.0470 | −0.0689 |
| | (0.51) | (−0.13) | (−0.30) | (−0.38) |
| Educated household head | 0.184** | 0.174 | 0.470*** | 0.325*** |
| | (2.21) | (1.32) | (4.65) | (2.89) |
| Household size | 0.0679*** | 0.0465** | 0.0874*** | 0.0487** |
| | (5.59) | (2.37) | (4.39) | (2.23) |
| Muslim household head | −0.0414 | −0.261* | 0.193+ | 0.345** |
| | (−0.42) | (−1.72) | (1.46) | (2.33) |
| *Community characteristics* | | | | |
| Presence of a phone | 0.103 | 0.0171 | 0.119 | −0.0311 |
| | (1.35) | (0.14) | (1.06) | (−0.25) |
| Presence of microfinance | 0.217** | 0.233* | 0.259** | 0.192+ |
| | (2.55) | (1.74) | (2.36) | (1.60) |
| Distance to a major road in km (logged) | −0.0224 | −0.0210 | 0.00300 | −0.000493 |
| | (−1.09) | (−0.67) | (1.42) | (−0.22) |
| Distance to the nearest market in km (logged) | −0.0770** | −0.0602 | −0.00225* | 0.000793 |
| | (−2.44) | (−1.15) | (−1.85) | (0.60) |
| Annual rainfall (mm) (logged) | 0.638*** | 0.423+ | −0.000337** | −0.000176 |
| | (3.95) | (1.63) | (−1.99) | (−0.91) |
| *Firm characteristics* | | | | |
| Distance between firms in km (logged) | −0.0663*** | −0.0629+ | −0.229*** | −0.0957* |
| | (−2.72) | (−1.62) | (−4.66) | (−1.79) |
| Home location | −0.453*** | −0.725*** | −0.440*** | −0.673*** |
| | (−6.59) | (−6.46) | (−4.44) | (−6.25) |
| Operation_months | 0.0163 | −0.0306+ | – | – |
| | (1.31) | (−1.48) | | |
| Operation_days | – | – | 0.0431*** | 0.0494*** |
| | | | (8.64) | (8.94) |
| Operations_seasonal | – | – | −0.309*** | −0.207** |
| | | | (−3.43) | (−2.12) |
| *Economic sectors* | | | | |
| Manufacturing and construction | −0.168* | −0.130 | −0.290*** | −0.334*** |
| | (−1.91) | (−0.93) | (−2.69) | (−2.84) |
| Mining | −0.847*** | −0.387 | −0.110 | −0.191 |
| | (−2.72) | (−0.86) | (−0.44) | (−0.76) |
| Services | −0.276*** | −0.443*** | −0.584*** | −0.259 |
| | (−3.00) | (−3.18) | (−3.15) | (−1.20) |
| Transport | 0.105 | 0.342* | −0.344** | −0.277+ |
| | (0.74) | (1.74) | (−2.10) | (−1.51) |

(*Continued*)

**Table 2.** Continued.

| | Nigeria | | Ethiopia | |
|---|---|---|---|---|
| **Variables** | **Output/worker** | **Value added** | **Output/worker** | **Value added** |
| *Regions/zones* | | | | |
| North Central | 0.150 | −0.0401 | – | – |
| | (1.26) | (−0.22) | | |
| North East | −0.0801 | −0.538** | – | – |
| | (−0.52) | (−2.19) | | |
| North West | −0.0594 | −0.109 | – | – |
| | (−0.40) | (−0.46) | | |
| South East | −0.663*** | −0.560** | – | – |
| | (−5.13) | (−2.45) | | |
| South South | −0.274** | −0.361* | – | – |
| | (−2.04) | (−1.68) | | |
| Tigray | – | – | −0.0459 | 0.356+ |
| | | | (−0.22) | (1.51) |
| Afar | – | – | −0.413 | −1.407*** |
| | | | (−1.07) | (−2.89) |
| Amhara | – | – | −0.0358 | 0.173 |
| | | | (−0.22) | (0.99) |
| Oromia | – | – | −0.210+ | −0.00836 |
| | | | (−1.45) | (−0.05) |
| Somalie | – | – | 0.166 | 0.284 |
| | | | (0.61) | (0.92) |
| Ben_Gumuz | – | – | −0.170 | 0.179 |
| | | | (−0.78) | (0.74) |
| Gambelia | – | – | 0.177 | 1.143*** |
| | | | (0.59) | (3.00) |
| Harari | – | – | −0.111 | −0.0224 |
| | | | (−0.38) | (−0.07) |
| Diredwa | – | – | −0.716*** | −0.488* |
| | | | (−2.69) | (−1.77) |
| _cons | 4.309*** | 6.800*** | 6.147*** | 5.039*** |
| | (3.59) | (3.52) | (16.64) | (12.33) |
| *N* | 1934 | 904 | 1063 | 846 |
| $R^2$ | 0.118 | 0.157 | 0.276 | 0.288 |

Notes: *t*-statistics are given in parentheses.
Significant at $+p < 0.15$; $*p < 0.10$; $**p < 0.05$; $***p < 0.01$.

In this study, rainfall is included as a proxy for agricultural performance. Rainfall has been noted as a major determinant of agricultural productivity and often increases in annual precipitation in Sub-Saharan Africa are associated with higher farm yields. Where non-farm enterprises are supported by proceeds from the agricultural sector, a positive relationship may be established between farm and non-farm sectors. On the other hand, where non-farm enterprises are established in response to low farm output, then a negative relationship may be observed between the performance of the farm and non-farm sectors. In Nigeria, increases in annual precipitation are associated with greater non-farm performance.

A number of firm-specific controls are also included in the model. The main variable of interest here is the measure of average distances between firms in the sample. It is observed that firm performance decreases with distance from other firms in the output per worker model specification, indicating that spatial proximity plays an important role in explaining firm performance in Ethiopia and Nigeria. Results indicate that at the disaggregated level, where social interactions and influence are more common, the local environment is important for rural non-farm enterprise performance. This may be as a result of knowledge spillovers, collective learning, and backward and forward linkages with local markets. According to

Haggblade, Hazell, and Reardon (2002), rural non-farm enterprises who are engaged in similar activities may cluster together in order to take advantage of larger markets for labour and consumption goods, scale economies, lower energy costs and external economies of agglomeration.

Firms that are located at home residences appear to perform worse than firms located outside the residence. Often times, businesses may be located at home due to the smaller initial start-up (Priesnitz, 1989). According to Loscocco and Smith-Hunter (2004), these businesses located at home tend to experience lower economic success than other businesses located outside the residence. This may be as a result of home commitments and domestic responsibilities that may lead to fewer hours of work (Olson, 1997). It may also be due to a smaller expansion capacity of the business due to space constraints at the home.

In Ethiopia, businesses perform better with increasing days of business operations within the month. Businesses that are seasonal perform worse than businesses whose operations are not seasonal in the output per worker model specification for Ethiopia. The paper also controls for heterogeneity in firm sectors of operations. Using the wholesale/retail economic sector as the base group, it is observed that in Nigeria businesses in the base group perform better than businesses in the other economic sectors of manufacturing and construction, mining and services under the first model specification. In Ethiopia, the same is true and businesses in the wholesale/retail sector perform better than businesses in the manufacturing and construction sector, the services and transport sectors. In the second model specification, businesses in the wholesale/retail sector in Nigeria perform better than businesses in the mining, services and transport sectors; while businesses in the wholesale/retail sector in Ethiopia perform better than businesses in the manufacturing and construction sector.

With respect to region controls, it is observed that similar to preliminary findings in the exploratory spatial data analysis, businesses in the south-western parts of Nigeria continue to perform better than businesses in other parts of the country, even controlling for other variables. In Ethiopia, the Southern Nations, Nationalities, and Peoples' Region (SNNP), a low-performing region from the ESDA, is used as the base category. In this paper, controlling for other factors, previously observed high-performing areas in Ethiopia like the Somalie and Oromia regions are no longer significantly different from other regions.

Overall, the results from the two model specifications appear consistent, although fewer observations are significant in the value-added specification due to the reduced sample size from the log-linearization of the dependent variable. A higher proportion of variation is explained by the models in Ethiopia compared with Nigeria.

## CONCLUSIONS

In recent years there has been a growing interest in the contribution of entrepreneurship to development (e.g., Naudé, 2010, 2011) and to rural development in Africa in particular (e.g., Nagler & Naudé, 2014a, 2014b; Rijkers & Costa, 2012). In rural Africa, the vast majority of households are dependent on farming for a livelihood. They engage in both farming and non-farming activities. The latter have been established as important for rural household income, generating on average more than 40% of rural household income in Africa.

While much research has gone into understanding the patterns of rural non-farm enterprises and their contribution to household income and to poverty alleviation, as well as to understanding the determinants of rural household participation in starting up and running such enterprises (e.g., Lanjouw, 2007; Nagler & Naudé, 2014a), there is still a gap in the existing knowledge about the performance of rural non-farm enterprises in Africa.

In particular, the performance, especially in terms of productivity of farms in Africa, has been extensively studied (e.g., Alene, 2010; Block, 2010); also, a number of studies have dealt with the possible benefits of non-farm enterprises for farm productivity (e.g., Oseni & Winters, 2009). No study has yet dealt with rural non-farm productivity in Africa satisfactory, and indeed none has as yet considered controlling for spatial autocorrelation and possible spatial spillover effects in the performance and productivity of these enterprises.

The present paper makes a modest contribution to addressing these two lacunas. Using appropriately georeferenced rural household data from Ethiopia and Nigeria, preliminary evidence of spatial clustering and autocorrelation in firm performance is presented. Additionally, it studies the determinants of rural non-farm enterprise performance, controlling for firms' proximity to one another.

It was established that spatial autocorrelation is significant. This means that studies into the determinants of rural enterprises in Ethiopia and Nigeria that omit controlling for spatial dependence/agglomeration effects will be subject to biased estimates. Hence, they used appropriately specified regression models to estimate the key determinants of the productivity of rural non-farm enterprises, using sales per worker as a (crude) productivity/performance measure.

From these, it was found that in both Nigeria and Ethiopia spatial proximity is a very important determinant of firm productivity. Furthermore, a negative relationship between rural non-farm enterprise performance and agricultural activity (as proxied by annual precipitation) in Ethiopia was also found, implying that increases in farm productivity are not necessarily associated with increases in non-farm enterprise productivity in the same region. It may be that in areas with high agricultural productivity and higher wages reduce the competitiveness of non-farm enterprises. Additional research may be conducted to establish if this negative relationship is due to the type of rural non-farm enterprise, to wages in agriculture or to some other unexplained characteristic of rural non-farm enterprises in Africa. In Nigeria, a positive relationship was observed between agricultural performance and non-farm enterprise performance.

Together, these findings finally allow one to draw a number of modest policy conclusions. First, the evidence

on the importance of spatial proximity to firm performance suggests that investment in local infrastructure, i.e., improvements in the local business environment in rural areas, will support the performance of non-farm enterprises. Second, the literature has long emphasized the importance of asset and knowledge accumulation of existing firms, and this process should be encouraged to the extent that existing firms appear to confer positive externalities on other firms in their neighbourhoods or clusters – increasing nearness of firms to each other is important in this regard. Policies to improve the skills and technology of potentially leading enterprises in the community may then spillover more easily on to other proximate enterprises. Third, the findings are consistent with that of many other papers dealing with enterprise performance that argue for the positive effects of entrepreneurial and management education for enterprise performance. The presence of community infrastructure such as access to ready markets and credit facilities is also an important determinant of firm performance. Fourth, home-based businesses were found to perform worse compared with other non-residence locations. Location may therefore be an important constraint to business performance and, therefore, it is important for governments in both countries to enact policies to respond to these location problems. It is important not only that these structures or stalls be made available but also that they be affordable to entrepreneurs. To solve the problem of location, more high-capacity buildings with stall spaces may be provided at affordable rates or with payment schemes that are affordable by business entrepreneurs.

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## DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

## SUPPLEMENTAL DATA

Supplemental data for this article can be accessed at http://10.1080/00343404.2015.1131896

## NOTES

1. The term 'rural non-farm enterprises' is used in this paper to refer to all rural business enterprises outside of farming; it includes, for example, shops, business services, transport (taxis), food processing and preparation, and construction, amongst others (e.g., Haggblade et al., 2010).
2. Productivity levels are also dispersed across countries; the literature suggests that the productivity of firms in African countries is, on average, lower than that of firms elsewhere (Nichter & Goldmark, 2009).
3. It is important to note the potential for errors in self-reported data on firm performance. The study by De Mel, McKenzie, and Woodruff (2009), for instance, shows that self-employed individuals tend to under-report enterprise revenues by about 30%.

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