Product innovations and informal market competition in sub-Saharan Africa: Firm-level evidence

Paper submitted for the 2016 Conference on Informality and Development- A Conference in Honor of Elinor Ostrom, Bloomington, Indiana, USA.

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Abstract

The competitive interactions between formal and informal firms in product markets continue to grow in developing countries. Firm level evidence however reveals the product market competitive behavior of informal firms as 'unhealthy' and one of the top three (3) obstacles formal businesses face in sub-Saharan Africa. With scant empirical evidence available, this paper fills the gap in the literature by investigating the relationship between informal product market competition and sales from innovative products introduced by formal firms using pooled data from the World Bank's Enterprise Survey and the newly available Innovation Follow-up Surveys for five (5) sub-Saharan African countries. Our results show a robust "Schumpeterian effect" (monotonically negative effect) of informal firm competition on the market performance of product innovations introduced by formal firms. Results from sectorial, ownership type and size of firm analyses also show similar "Schumpeterian effects". However, extension to industry-level informal competition indicates an "escape-competition effect" of informal competitive activities on the performance of product innovations. We also found through indirect mechanisms that firms with larger market share tend to have "escape - competition effects". We argue that, informal competition matters for the introduction and performance of product innovations but only for formal firms that lack strategic collaborative 'footholds' in the informal sector.

Key words: Informality, market competition, product innovations, firms and sub-Saharan Africa.

1. Background

The informal sector has defied the expectations of traditional development literature by not only persisting over time but have also grown and expanded over the years. The growing widespread evidence of the "permanent feature" of the informal sector in developing countries has led to the increasing academic and policy interests in recent years (see Elahi & de Beer, 2013; Biles, 2009; Chen, 2006). Typically, development literature considers informal firms and the activities of informal firms as largely negative on the economy. Evidence from firm level data from developing countries also reveal the market competitive behaviors of informal firms as one of the top 3 obstacles formal businesses face in product markets (see Mendi & Costamagna, 2015; Ali & Najman, 2015; Friesen & Wacker, 2013; Lamanna & Gonzalez, 2007). Despite the growth of the literature on informality, the economic implications of informal firms' activities remain under researched (Mendi & Costamagna, 2015; Friesen & Wacker, 2013; Bruton, Ireland, & Ketchen Jr., 2012) with very scant empirical studies investigating the effect of informal product market competition (hereafter informal competition) on the innovation strategies of formal firms. This study aims to fill this gap by examining the effect of informal competition on sales from innovative products introduced by formal firms' in sub-Saharan Africa (SSA).[1]

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[1] A growing related literature is the informal competition and formal firms productivity literature (See La Porta & Shleifer, 2008 ; Ali & Najman, 2015).

In developing countries, the informal economy is increasingly being seen as a critical socio-economic pillar (Gërxhani, 2004) and a source of livelihood (La Porta & Shleifer, 2008) with highly heterogeneous firms (ADB, 2013; Olivier & Kwenda, 2011). The informal sector is most prevalent in SSA (Schneider, Buehn, & Montenegro, 2010) where it dominates economic activities both in terms of output and employment (Singh, 2005; Timalsina, 2007; Heintz & Pollin, 2008). For instance, the sector constitutes 80 percent of the labour force and accounts for nearly 55 percent of GDP for many SSA countries (ILO, 2013; ADB, 2013). In Ghana, employment is found to be predominantly informal, employing 86.1% of the working force (Ghana Statistical Service, 2012) with the production structure made up of Small-Medium Enterprises (SMEs). Informal sector SMEs are also found to be strong drivers of economic transformation (Haug, 2014).

In addition to serving as a source of livelihood in many developing countries, the informal sector serves as a source of product market competition (Mendi & Costamagna, 2015; Lamanna & Gonzalez, 2007) through prices at the "local level" at least (Ali & Najman, 2015; Lamanna & Gonzalez, 2007) where the competitive interaction is found to occur in product markets for the same consumers (Lamanna & Gonzalez, 2007). While market competition between firms is recognized widely as the driver of efficiency and growth (Ali & Najman, 2015), empirical evidence (see Friesen & Wacker, 2013; Lamanna & Gonzalez, 2007) and firm level data from developing countries (mostly from the World Bank Enterprise Surveys) often cite competitive behaviors of informal firms as 'unhealthy' and as one of the top three obstacles to formal firms. The characterization of informal competition as 'unhealthy' may be, as noted by Mendi & Costamagna (2015), a result of the wide market acceptance of informal firms in local markets, particularly, markets serving those in the bottom of the pyramid.

In the face of informal competition, formal firms often employ vertical product differentiation in order to stay competitive (Mendi & Costamagna, 2015). In other words, formal firms introduce product innovations. According to van Dijk & Sandee (2002), Gault (2010) and OECD & Eurostat (2005), innovations particularly product innovations remain a primary driver of firm technological competitiveness(market performance) through improvements in product quality, offering of new products or opening up new markets or groups of customers thereby increasing the firms market share. However, imitation and the increasing complementary interaction between formal and informal firms coupled with the dynamic behaviors of informal firms may be blurring vertical product differences particularly in service and retail sectors. Consequently, the competitive advantage formal firms enjoy with vertical product differentiation may be fuzzy in the face of informal competition.

The relationship between innovation and competition in SSA is of particular interest as a result of the growing size of the informal sector as well as the peculiar nature of competition presented by the dualistic economic structure. This paper therefore aims to empirically investigate the effect of informal market competition on the performance of innovative products of registered

firms in SSA and to provide a better understanding of the mechanism through which these occurs.

This paper contributes to the literature in several ways. The paper provides, to our knowledge, the first empirical evidence assessing the effect of informal product market competition on the sales of innovative products.[2] This study departs from the mainstream literature by analyzing informal product market competition and from similar studies by going beyond the analysis of formal firms incentives to innovate. What may be relevant for firms is not whether to introduce product innovations or otherwise, but how the innovative product will perform on the market in the face of dual competition. Analyzing the effect of informal competition on product innovation using a binary dependent variable (whether the firm introduces product innovation or not) only determines the incentives to innovate or otherwise. This paper therefore contributes to the literature by going beyond establishing the relationship between informal competition and the probability of the firm to introduce product innovation by assessing the effect of informal competition intensity on the performance of product innovations in SSA.

This paper also contributes to the literature by resolving possible econometric issues of bi-directional causality and the use of subjective responses that may bias our estimates. Using already existing econometric procedures developed by Guiso, Sapienza, & Zingales (2004), Ali & Najman (2015) finds that informal competition varies across regions within the same country. This study follows Ali & Najman (2015) to construct an innovative regional competitive intensity measure that 'localizes' competition thereby reducing the possible bi-directional causality between informal product market competition and sales of innovative products as well as controlling for possible bias due the subjective nature of the data (Ali & Najman, 2015). We also employed the same procedure to construct industry-level informal competition indicator across industries in each country. These econometric technics allow us to control and introduce nonlinear effects into our model that could explain more rigorously the relationship between informal competition and formal firms' technological innovativeness (see Ali & Najman, 2015; Aghion, Bloom, Blundell, Griffith, & Howitt, 2005; Scherer, 1967). This paper also follows available econometric methods to control for selection bias associated with innovation where we allow the error terms of both equations to be freely correlated.

In addition, this study contributes to the literature by employing the newly available Innovation Follow-up Surveys (IFS) pooled with the Enterprise Surveys (ES) from the World Bank. While similar studies also employ the ES (see Mendi & Costamagna, 2015; Ali & Najman, 2015; Friesen & Wacker, 2013; Lamanna & Gonzalez, 2007), this study departs my pooling data from both ES and the IFS thereby exploiting larger number of variables in order to uniquely introduce controls that are uncommon in the literature.

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[2] A recent contribution by Mendi & Costamagna (2015) focuses on the implications of informal competition on the incentives of formal firms to introduce product and/or process innovations. This paper however departs by considering the degree of product innovative sales as well as conducting an indepth econometric analysis of the relationship between product innovative sales and informal competition.

Using data for five (5) SSA countries namely: Democratic Republic of Congo, Ghana, Tanzania, Uganda, Zambia and employing two econometric approaches that localize informal competition in the product market at the first level of estimation and controls for self-selection and sample selection biases at the second level of estimation, we have shown that 'local' informal competition matters for the performance of product innovations. Specifically, our results indicate the presence of the 'Schumpeterian effect' where informal product market competition is found to be detrimental to the performance of product innovations. Our conclusions are also found to be valid when we decomposed formal firms into sectors, ownership type and size. However, extension to industry-level informal competition indicates an "escape-competition effect" of informal competitive activities on the performance of product innovations. Our results also show through indirect mechanisms that, firms with larger market shares tend to have "escape - competition effects".

The rest of the paper is organized as follows. Section 2 presents the review of relevant literature on the relationship between innovation and product market competition. In Section 3, the model and sources of data are presented. Section 4 presents the results from the empirical estimation in line with the objectives of the paper, the discussion of the results as well as the appropriate robustness checks to validate our results. Section 5 presents the conclusion of the paper.

2. Related literature
The economic development literature establishing firm-level relationship between competition and innovation is relatively developed but remains central in both academic and policy spheres (Blundell, Griffith, & Van Reenen, 1999; Peroni & Ferreira, 2011) as empirical evidence remains inconclusive (Aghion et al., 2005) and 'subtle' (Aghion, Howitt, & Prantl, 2013). This section situates/relates this paper into these broad strand of literature.[3]

The literature mainly follows from the seminal contribution by Schumpeter (1942) with theoretical formalization by Aghion & Howitt (1992). The 'Schumpeterian perspective' of the literature essentially considers vertical innovations as 'creative destructions' of the product market and the source of long-run growth. Competition is considered a bane on innovations as it is considered to destroy the underlying incentives of firms to undertake innovative activities through the prospects of lower rents (Schumpeter, 1942; Aghion & Howitt, 1992; Aghion, Harris, Howitt, & Vickers, 2001; Hashmi, 2013). This is referred to as the "Schumpeterian effect". Using panel data from the United States of America (USA) and the United Kingdom (UK) and one minus the average Lerner's index of firms' industry, citation-weighted patents for competition and innovation respectively, Hashmi (2013) found evidence of a "Schumpeterian effect"-"mildly negative" relationship- in USA industries.

Contrary to the 'Schumpeterian perspective' is the "escape- competition effect" where increases in competition serves as an incentive to escape market rivalry by stimulating innovative activities and innovations particularly in industries with low technological gap (see Blundell, Griffith, & Van Reenen, 1999; Aghion et

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[3] See Gilbert (2006) for a recent survey of the literature.

al., 2001). For instance, Blundell et al. (1999) studied the 'market share, market value and innovation in a panel of British manufacturing firms' by using innovation counts. The authors found 'escape-competition effect' where "increased product market competition in the industry tended to stimulate innovative activity" with innovative, large market share firms enjoying higher gains on the stock market. Boldrin & Levine (2008) developed a competitive model of innovation where the authors examined post innovation rents under perfect competition. Presenting both "theoretical and practical" situations, the authors also found positive effects of competition on innovation.

A growing part of the literature also identifies a non-linear relationship in the form of an inverted U where both lower and higher levels of product market competition inhibits innovation while 'intermediate range' levels of product market competition promotes firm level innovation. In other words, this strand finds both the "Schumpeterian effect" and the "escape- competition effect" (see Aghion, et al., 2005; Scherer, 1967). An earlier study by Scherer (1967) analyzed the effect of market concentration on innovative efforts using data for 56 industries in the USA. Measuring innovative efforts as employment of scientists and technical engineers and market concentration as industry average concentration ratios weighted by shipment values, the authors found lower industry concentrations tend to promote innovative efforts while higher concentrations beyond a threshold tend to inhibit innovative efforts. Similar inverted U relationship has being recently identified by Aghion et al. (2005). In a UK panel data investigation where innovation and competition are measured as average weighted patents and the Lerner's index respectively, Aghion et al. (2005) also found an inverted U relationship between product market competition and innovation. The authors argue that, industries with low technological gaps tend to have fims that are "neck-to-neck" and competition in these industries tend to lead to lower "preinnovation rents." As a result, incumbent firms try to "escape competition" by increasing the technological gap and "postinnovation rents" through innovations. Reversely, "leader-laggard" firms dominate industries with higher technological gaps. Higher product market competition in these industries with "leader-laggard" firms tend to reduce "postinnovation rents" of leaders resulting in the dominance of the "Schumpetarian effect".[4]

One major criticism of the literature reviewed above remains that, majority of the studies concentrate on developed countries where competition is essentially non-dualistic. This study departs from this literature by analyzing a different type of competition, that is, informal product market competition. Most of the available literature also measures competition only at the industry level. We argue that, informal competition is also 'local'.

This paper departs by analyzing competition from a dualistic perspective by considering informal competition. There is a growing body of literature understandably from Latin America and Africa on informal competition and the effect of informal competition on the performance of formal firms. Employing mainly cross-sectional data from the World Bank's Enterprise surveys, some of these empirical works find informal competition and the activities of informal

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[4] See Aghion et al. (2005 page 702)

sector firms' detrimental to the performance of formal firms and the economy as a whole (Lamanna & Gonzalez, 2007; La Porta & Shleifer, 2008; Friesen & Wacker, 2013). Informal competition is found to most adversely affect formal firms that are: small (Lamanna & Gonzalez, 2007, Ali & Najman, 2015); financially constrained (Friesen & Wacker, 2013); tax constrained and in industries with high entry cost, low capital and higher regulations (Lamanna & Gonzalez, 2007; Friesen & Wacker, 2013). On the contrary, Ali & Najman (2015) found informal competition has productivity enhancing effects. Using the ES for 33 sub-Saharan African countries, the authors found that, formal firms with higher informal competition tend to increase their productivity with these effects increasing for large firms. In a cross country analyses of Latin and African countries using average regional measure for informal competition, Mendi & Costamagna (2015)[5] found an inverted U relationship where informal competition has decreasing and increasing effects on the probability of introducing innovations at higher and lower intensisties of competition respectively. Whiles these studies provide some level of evidence of the effect of informal competition on the performance of formal firms, the evidence remains mixed. Evidence relating to the effect of industry-level perception of informal competitive behaviours on the performance of product innovations also remain missing in the literature. Mendi & Costamagna (2015) considered the effect of informal competition on the probability of introducing product and process innovations. Our analysis go further by considering the performance of innovations as well as using rigourous econometric approaches to provide a much deeper insight into the relationship.

3. Methodology
3.1 Data
The main datasets used for the empirical investigation come from the Enterprise Surveys (ES) and the Innovation Follow-Up Surveys (IFS) of the World Bank.[6] The ES follows a standard methodology to collect representative enterprise data in 122 countries allowing for cross-country comparisons. The methodology randomly stratifies firms by sector, size and location thus making the sample in each country representative. The Innovation Follow-Up Surveys are representative firm-level data on innovation and innovative activities of firms interviewed during the ES. The IFS are follow-up surveys to the ES. The Innovation Follow-Up Surveys covered 19 countries between 2011-2014 out of which 15 of the countries covered are in Africa. In this paper, we employ data for five (5) SSA countries namely: Democratic Republic of Congo (DRC), Ghana (GH), Tanzania (TZ), Uganda (UG) and Zambia (ZAM).[7]

In this paper, we merged the ES and the IFS at all country levels using a unique country identifier by considering only countries that collected both ES and IFS in the same year.[8] We then appended all merged country datasets using a global unique identifier for larger sample size as all individual countries have large missing values for almost all variables of interest. For instance, only few firms in

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[5] The only known empirical evidence studying informal competition and innovation.

[6] Both manufacturing and service sector firms are covered in these datasets.

[7] We excluded other countries due to missing observations of variables of interest.

[8] Ethiopia, Rwanda, and Zimbabwe are also excluded as the sampling methodologies employed in the IFS differ from the ES global methodology.

each country recorded information for our main variables of interest such as "percentage of sales from new product innovation". Appending all the datasets across countries guarantees a larger sample size. The pooled data however provides a unique number of variables such as the sales from innovative products and region that is used to construct our regional intensity of informal competition. In total, data for five (5) SSA countries totaling 2,466 firms were attained. Appendix 1 presents the list of countries, the year of the surveys and the number of firms from each country under study.

To control for differences in currency and price changes across countries, we standardized our sales variables using exchange rate data and implicit price deflators' data from the World Bank's World Development Indicators and the United Nations System of Accounts with base year 2005 respectively.

The descriptive statistics for our data are shown in Table 1. Out of 2,466 firms in the data, 2,456 responded to introducing product innovations or otherwise. 955 firms making up about 38.9% introduced product innovations while 1,501 firms making up about 61.1% did not introduce any product innovation. The average percentage sales from all product innovations across all countries under consideration is about 34.97% with Zambia having the least average percentage sales from all product innovations of about 25.97%. Out of 2,378 responding firms, 39.11% considers competition from informal sector firms as a major constraint. Country specific descriptive however show varying perceptions with about 47.44% and 27.43% of Zambian and Ghanaian firms' respectively identifying informal sector competition as a major constraint to their businesses. Table 1 also shows the sectorial and size distributions of our data. Majority of firms (65%) in our data are classified as small with total number of workers between 5 and 19. Sectorial distributions show almost equal proportions of about 49% and 51% for manufacturing and service sector firms respectively.

Table 1: Descriptive statistics of data by country

	ALL	DRC	GH	TZ	UGA	ZAM
No. of firms in data	2,466	385	549	543	449	540
Product innovation						
No. of all firms	2456	383	544	541	448	540
Innovators	955	147	154	89	238	327
Non-innovators	1501	236	390	452	210	213
Sales from all product innovations (Mean %)	34.970	44.946	36.65	43.5	37.64	25.97
Informal competition						
No of all firms	2378	364	523	519	445	527
Major obstacle (%)	39.11	37.36	27.34	44.89	37.75	47.44
No obstacle (%)	60.89	62.64	72.66	55.11	62.25	52.56
Size of firm						
Small (%)	65.17	70.65	68.85	55.43	67.04	65.74
Medium (%)	26.64	23.38	25.87	29.83	25.84	27.22
Large (%)	8.19	5.97	5.28	14.73	7.13	7.04
Sector of firm						
Manufacturing (%)	49.31	47.79	51.73	50.09	46.33	49.63
Services and retail (%)	50.69	52.21	48.27	49.91	53.67	50.37

Source: Computed from ES and Innovation Follow Up Surveys.

3.2 Models

The ES methodology as noted, randomly stratifies firms by sector, size and location, which are assumed to be 'exhaustive' and 'non-overlapping'. However, the number of firms sampled in each stratum (sector, size and location) and across these strata are non-random resulting in non-random total sample size (Wooldridge, 2002). In addition, a firm's decision to introduce product innovation onto the product market is not random but often influenced by plethora of confounders. As a result of the non-random nature of the decision to introduce product innovation and the sampling design used in the ES, employing OLS may give inconsistent estimates due to the likely selection bias (see Heckman, 1979; Wooldridge, 2002). The empirical literature also recognizes bi-directional causality between innovation and competition and the need to resolve the possible endogeneity bias (see Aghion et al., 2005). The ES firm level data regarding the product market competitive behaviors of informal firms are mainly perception data and have been found to be highly subjective and may bias estimates (see Mendi & Costamagna, 2015; Ali & Najman, 2015; Friesen & Wacker, 2013; Lamanna & Gonzalez, 2007) as bad performing formal firms are more likely to exaggerate the competitive behaviors of informal firms more than good performing firms.

This section addresses the above possible biases by employing two main econometric approaches to estimate the informal product market competition on the percentage sales from all innovative products of formal firms. At the first level of estimation, we employ a two-step methodology developed by Guiso et al. (2004) and updated by Ali & Najman (2015) to construct 'local' and industry-level (in extension) informal product market competition indicators to address the possible endogeneity and subjectivity in the data. At the second level of estimation, we employ Type II Tobit model (Amemiya, 1985) to estimate the effect of our informal product market competition indicators (normalized marginal probabilities) on percentage sales from all innovative products and other relevant covariates controlling for self-selection and sample selection biases.

3.2.1 Model specifications
First level estimation- 'Local' informal competition indicator construction
In this section, we present a two-step econometric procedure developed by Guiso et al. (2004) and updated by Ali & Najman (2015) to construct our informal product market competition indicators. As noted, the standardized ES collects firm level perception data on the product market competitive behaviors of informal firms. These perception responses from formal firms have been found to be highly subjective (Ali & Najman, 2015; Friesen & Wacker, 2013). As a result, using local (regional) averaged responses where firms operating in the same locality (region) have the same 'local' informal product market competition indicator thereby allowing for variations across regions within the same country have been found to mitigate the subjective bias and measurement errors in the data as well as reduce the bi-directional relationship between informal competition and innovation (see Ali & Najman, 2015; Friesen & Wacker, 2013).

Following Lamanna & Gonzalez (2007) and Ali & Najman (2015), we assume informal product market competition is at first only 'local' with informal firms

competing only in their immediate vicinities. That is, firms' operate in their immediate product markets with no or very little competitive interaction in national and/or global product markets. Several questions in the standardized ES seek to find out how formal firms perceive the competitive behaviours of both formal and informal firms. In the construction of our 'local' informal product market competition indicator, we employ data on the question:

Do you think the practices of competitors in the informal sector present:
a)   No obstacle
b)   Minor obstacle
c)   Moderate obstacle
d)   Major obstacle
e)   Very severe obstacle ...
to the current operations of your establishment?

In the ES dataset, this question is further summarized into:

Percentage (%) of firms identifying competitors in the informal sector as a major constraint.

The later question presents a binary classification that takes the value 1 if the firm considers the competitive practices in the informal sector as a major and a very severe obstacle and the value 0 if the firms consider the competitive practices in the informal sector as no, minor and moderate obstacles respectively. Following Ali & Najman (2015), we use the binary classification to formalize a non-linear probit regression equation as:

$$\text{Informal competition}_{ij} = \gamma_0 + \gamma_{qj}Region_{qj} + \gamma_2 X_{ij} + \gamma_I + \gamma_y + \gamma_C + \varepsilon_{ij} \quad (1)$$

where Informal competition$_{ij}$ is a binary variable taking the value 1 if firm i in country j considers the competitive practices in the informal sector as a major obstacle and value 0 if the firm i in country j considers the competitive practices in the informal sector as no obstacle. Region$_{qj}$ is our 'local' informal product market competition variable which is a list of regional dummies in country j. X_{ij} $\gamma_I, \gamma_y, \gamma_C$ are defined as vector of all firm-specific, industry, year and country-specific variables that respectively explain firms' perception of informal market competitive behavior in the product market. [9]

The marginal effects from the first-level probit regression of equation 1 are shown in Appendix 3. The results indicate that, foreign owned firms are less likely to identify the competitive practices of informal firms as a major constraint as compared to domestic firms all other factors held constant. The probability that formal firms identify the competitive activities of informal firms as a major constraint increases if other obstacles to business such as corruption and crime are present. Firms located in the capital city consider the informal firm competition less a major constraint as compared to firms located elsewhere. Firms with higher percentage increase in total sales from the previous fiscal year are less probable to perceive informal sector competition as a major constraint.

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[9] See Appendix 2 for definition of all terms and variables.

In the second stage, we predict the marginal probabilities of $Region_{qj}$ from the estimation of equation 1 with firms operating in the same vicinity having the same informal competition intensity (marginal probabilities).[10] The marginal probabilities in region q of country j is then normalised to values between 0 and 1 with firms having the least informal competition intensity assigned the value zero while the region with the highest informal competition intensity assigned the value 1. This is done formally by following Ali & Najman (2015) as:

$$IPMC_{qj} = \widehat{\gamma_{qj}} - min(\widehat{\gamma_{qj}}) \Big/ max(\widehat{\gamma_{qj}}) - min(\widehat{\gamma_{qj}}) \qquad (2)$$

where $IPMC$ is 'local' informal product market competition indicator in region q of country j. $\widehat{\gamma_q}$ are the marginal probabilities of region q in country j. $max(\widehat{\gamma_{qj}})$ and $min(\widehat{\gamma_{qj}})$ refer to the maximum and minimum marginal probabilities respectively. Equation 2 normalizes our 'local' informal product market competition indicator into a range between zero (0) and one (1) where values close to 1 indicate intense informal competition and values close to 0 indicating less informal competition in the vicinity.

Description of our regional variable, country of location and their respective 'local' informal competition indicators in percentages are presented in Table 2.

Table 2: Description of regions and IPMC indicator

Country	Region	Number of firms	Local informal competition indicator (IPMC) (%)
Congo, D.R.	Central	51	29.827
	East	95	16.170
	South	47	21.193
	West	192	63.265
Ghana	Accra	275	43.485
	North	106	16.484
	Takoradi	54	32.496
	Tema	114	13.187
Tanzania	Arusha	92	3.140
	Dar Es Salaam	268	32.810
	Mwanza	53	24.490
	Zanzibar	74	52.590
Uganda	Jinja	79	73.626
	Kampala	165	87.912
	Lira	37	0
	Mbale	48	2.512
	Mbarara	54	9.419
	Wakiso	66	57.614
Zambia	Kitwe	74	70.330
	Livingstone	73	67.033
	Lusaka	288	100
	Ndola	105	64.835
TOTAL	**22**	**2,410**	

A look on Table 2 shows varying intensities of 'local' informal product market competition indicator across different regions of the same country. Lira, in Uganda has the least intensity of 'local' informal competition while Lusaka is

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[10] Accra was used automatically as the base outcome.

found to have the highest intensity of 'local' informal competition. In Tanzania for example, Arusha has the least intensity of informal product competition of about 3.1% while Zanzibar has the highest intensity of informal competition of about 52%. These regional disparities across all countries validate our use of the 'local' indicator rather than a national proxy for informal product market competition as we see varying levels of informal competition across regions of the same country.[11]

There exist disparities across countries as well as across product innovators and non-product innovators. On the average, Tanzania has the lowest intensity of informal competition of about 29% while Zambia has the highest of about 85%. On the average, innovators experience a higher intensity of informal competition of about 57% as compared to the 44% of intensity experienced by non-product innovators. Cross-country comparison indicates on the average that, both product and non-product innovators in Zambia experienced the highest intensity of 'local' informal competition of about 86% and 83% respectively (see Table 3).

Table 3: Description of 'local' informal competition indicator by country

	ALL	DRC	GH	TZ	UGA	ZAM
'Local' informal competition indicator (IPMC)						
All firms (Mean %)	48.919	42.079	30.899	29.305	55.131	84.640
Innovators (Mean %)	56.706	41.839	31.531	32.091	50.495	85.862
Non-innovators (Mean %)	43.914	42.248	30.614	28.729	60.296	82.763

Source: Computed from ES and Innovation Follow Up Surveys

Second level estimation- Type II Tobit model
To estimate the effect of our local informal product market competition indicator on sales from all innovative products, we formulate a Type II Tobit model (Amemiya, 1985) procedure as:

Regression equation:
$$Sales_{Product\ Innovation\ ij} = Y_{ij} = \alpha_0 + \alpha_1 IPMC_{qj} + \alpha_2 Z_i + \delta_I + \delta_y + \delta_C + \varepsilon_{ij}, if\ w_i^* > 0 \qquad (3a)$$

Selection equation:
$$Introduces_{Product\ Innovation\ i} *= (w_i^*) = \beta_0 + \beta_1 M_i + \mu_{ij}, \ w_i = 1\ if\ w_i^* > 0\ and w_i = 0\ otherwise \qquad (3b)$$

where $Sales_{Product\ Innovation\ ij}$ is the percentage of sales from all innovative products of firm i in country j, $IPMC_{qj}$ is our 'local' informal product market competition indicator in region q of country j. Z_i is the set of control covariates. $\delta_I, \delta_y, \delta_C$ are industry-specific, year specific and country specific covariates that may affect the percentage of sales from all innovative products. $Introduces_{Product\ Innovation\ i}$ is a dummy which takes value 1 if firm i in country j introduced product innovation over the last three (3) fiscal years and zero if otherwise. M_i is a set of control covariates that might affect firm i in country j to

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[11] See also Ali & Najman (2015)

introduce product innovation and vice versa. ε_{ij} and μ_{ij} are both multivariate normally distributed error terms. Y_{ij} in the regression equation is set to zero when w_i in the selection equation is zero and positive when w_i is one.[12]

3.3 Estimation
To estimate the Type II Tobit models, we employed the 'flexible' cmp-conditional mixed process (cmp) Stata command which performs a limited-information maximum likelihood estimation by assuming the errors from both the regression and selection equations can be correlated and are multivariate normally distributed (see Roodman, 2011). The parameters obtained from the simultaneous estimation of both the regression and selection equations have been found to be 'generally more efficient' due to the use of the full covariance structure in both equations (Roodman, 2011). All regressions are clustered at the region.

4. Empirical results and discussion
The empirical results from regressing our 'local' informal competition indicator on percentage sales due to all product innovations are reported in panel A of Table 4. To test the consistency of our empirical results, we also regressed our 'local' informal competition indicator on total sales due to all product innovations in US dollars as reported in panel B of the same table. All results for both basic and extended specifications are standardized.

Our main results from panels A (2) and B (4) of Table 4 are complementary and show that, informal competition in product markets have a significantly negative effect on the performance of product innovations. That is, increase in the concentration of informal firms' activities in the immediate vicinity of formal firms reduces the percentage sales from all newly introduced product innovations. This result is in line with the empirical findings of Hashmi (2013). One explanation for this "Schumpeterian effect" may be due to the large differences in the technological competitiveness of formal and informal firms'. As a result of the technological gap, firms may not be neck-to-neck resulting in lower performance of product innovations with increases in informal competition. This result may also be explained by the increase in the non-competitive interactions between few formal firms and informal sector firms mainly through collaborations and outsourcing of economic activities. These non-competitive interactions may be enabling the few registered firms to expand their market size through informal firms by taking strategic advantage of the dynamic behaviors as well as the 'local' market acceptance of these unregistered firms. As a result, formal firms without these non-competitive interactions may face intensive competition from informal firms who happen to be most active and visible competitors in product markets with similar 'imitated' products. These market behaviors maybe eroding the competitive advantage formal firms' without non-competitive interactions enjoy with vertical product differentiation resulting in lower sales of product innovations. This result may

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[12] According to Wooldridge (2002, p. 562), setting Y_{ij} =0 when w_i=0 is 'misleading'. We argue this is a plausible argument in this paper as non-innovative firms (w_i=0) in our data have Y_{ij} =0 while all innovating firms (w_i=1) however have Y_{ij} >0.

also partially explain the recent persistence of growth and economic relevance of the informal sector in SSA.

Table 4: Effect of informal product market competition on sales from all product innovations.

	A			B	
	(1)	(2)	(3)	(4)	(5)
	Percentage sales due to all product innovation			Total sales due to all product innovations ($)	
Local informal competition (IPMC) (%)	-0.139	-0.192***	-0.605***	-1.831**	-5.502***
	(0.104)	(0.060)	(0.129)	(0.806)	(1.921)
Log of sales lagged 3 (USD)		-0.941	-2.611***	13.957	-0.823
		(0.895)	(0.991)	(12.270)	(13.316)
IPMC*Log of sales lagged 3 (USD)			3.726***		35.36**
			(1.111)		(17.22)
Tax		-2.270	-1.047	-9.621	1.054
		(4.061)	(3.950)	(53.122)	(54.565)
Corruption		-6.917***	-7.125***	-99.569***	-101.373***
		(2.341)	(2.497)	(36.362)	(37.790)
IPMC* Corruption			-9.254**		-222.3***
			(4.567)		(66.94)
Licensing		5.409***	5.486***	79.832***	80.604***
		(1.759)	(1.803)	(21.272)	(21.631)
Crime		-1.401	-2.152	-55.371	-62.062
		(2.960)	(3.038)	(42.719)	(43.705)
Size of locality (250,000-1m)		-5.221**	-2.692	-55.513*	-33.346
		(2.317)	(2.400)	(30.412)	(32.312)
Size of locality (50,000-250,000)		-7.881*	-5.762	-173.334**	-155.000*
		(4.411)	(4.598)	(77.162)	(81.434)
Size of locality (less than 50,000)		-8.941***	-9.050***	-116.098***	-117.064***
		(2.418)	(2.505)	(25.688)	(25.754)
Log of labour cost per worker		-0.490	-0.663	-2.263	-3.786
		(0.851)	(0.864)	(10.257)	(10.613)
Log of total employment lagged		0.740	0.398	10.526	7.393
		(1.825)	(1.642)	(26.079)	(24.752)
Ownership		3.490	3.245	78.423	76.379
		(3.387)	(3.481)	(55.961)	(57.196)
Log of Experience		-4.421**	-4.509**	-51.725**	-52.471**
		(2.003)	(1.866)	(21.665)	(21.051)
Support		8.940*	9.599**	113.624**	119.233**
		(4.957)	(4.395)	(56.390)	(50.680)
Log of Age		17.408*	17.537**	290.432**	291.384**
		(9.008)	(8.451)	(133.031)	(127.286)
Log of Age Squared		-3.152**	-3.295**	-55.772**	-57.010**
		(1.592)	(1.460)	(24.231)	(22.853)
Country$					
Ghana	-9.834***	-10.658***	-9.529***	-79.823***	-69.712**
	(3.603)	(2.343)	(2.896)	(23.708)	(27.815)
Tanzania	-4.181	-5.853	-3.389	-30.496	-8.243
	(4.491)	(4.631)	(5.043)	(49.172)	(54.402)
Uganda	-5.720	-2.254	-3.981	-69.038	-84.405*
	(5.548)	(3.661)	(3.174)	(47.651)	(45.112)
Zambia	-12.586**	-5.488	-11.534*	-107.362*	-161.283**
	(5.999)	(5.615)	(6.533)	(61.769)	(77.769)
Constant	50.052***	63.053***	83.57***	332.377*	489.8***
	(5.657)	(12.286)	(12.70)	(182.164)	(166.2)
N	1659	1251	1251	1251	1251

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions include size, year, sector and 23 industry dummies. All coefficients and standard errors are robust to heteroskedasticity.

$ Congo, Democratic Republic as base country.

To understand the main transmission mechanisms through which 'local' informal competition affects the performance of product innovations, we interacted our informal competition indicator with corruption and log of total sales lagged. Our results show that, firms' that experience higher percentage sales from three fiscal years ago and perceive corruption as no obstacle to their business tend sell more of all product innovations with increases in the intensity of 'local' market competition holding other factors constant. Contrary, firms' that experience higher percentage sales from three fiscal years ago and perceive corruption as a major obstacle to their business tend sell less of all product innovations with increases in the intensity of local market competition holding other factors constant. Our results also show that, growth in total sales tend to have a positive effect on the performance of product innovations with increases in informal competition. This may imply that, firms with larger market share - most likely attained from the strategic collaborations and outsourcing of economic activities with informal firms- may consider corruption as no obstacle and as a result still benefit from introducing product innovations with larger presence of informal firms working to boost sales of their new innovative products. As a result, further vertical differentiation through the introduction of new products result in higher sales even with increased informal competition.

As noted by Blundell et al. (1999), an alternative explanation for this result may be that, some firms sell more of innovative products because they have 'marketing advantages' as compared with other firms. We verified this assertion by introducing a marketing dummy that captures whether a firm used services of marketing firm or consumer research firm or an advertising firm. Results as shown in Appendix 4 are similar to our results in Table 4. We however find that, firms that employed marketing services actually perform better with sales of innovative products than otherwise.

4.1 Extensions to sector, size and ownership
We extend our analyses to examine the effect of 'local' informal competition between manufacturing versus service sector firms, domestically owned firms and small versus medium sized firms. The empirical results are reported in Tables 5, 6 and 7.

The standardized results showing the effect of informal competition on the percentage sales due to all product innovations of manufacturing and service sector firms are presented in Table 5. Results show that, informal competition in product markets affect negatively the performance of product innovations introduced by formal firms both in the manufacturing and service sectors. One explanation for this result maybe that, majority of formal firms in both sectors operate at low levels of technology. As a result, informal firms are capable of imitating new products introduced onto the product market resulting in higher competition and hence weak performance of product innovations. We however find the negative effect of 'local' informal competition to be greater on service and retail sector firms as compared to manufacturing sector firms. An explanation for the differences in the effect on manufacturing and service firms may be due to the differences in the level of technologies used. The service sector generally employs low levels of technology and requires less know-how

and hence easy to 'imitate'. Manufacturing sector however requires a higher level of technology and technical know-how and as a result may be experiencing lower levels of 'imitations' coupled with higher levels of collaboration with the informal sector. This may be leading to the better performance of product innovations from the manufacturing sector as compared with the service and retail sectors. These results are robust across all specifications.

Our results also show that, manufacturing firms' that experienced higher percentage sales from three fiscal years ago and do not perceive corruption as an obstacle tend to sell more of all newly introduced product innovations with increases in the intensity of informal competition holding other factors constant than otherwise. This result means that, market size is relevant for the performance of product innovations. The results also show that, manufacturing firms' that perceive and identify corruption as a major obstacle to their business tend to sell less of all newly introduced product innovations with increases in the intensity of informal competition even with gains in market share holding other factors constant. We find similar indirect mechanisms of sales for service sector firms as well. However, we find the indirect sales mechanism to be much effective in the service sector than in the manufacturing sector. That is, service sector firms' that experienced higher percentage sales from three fiscal years ago tend to sell more of all newly introduced product innovations with increases in the intensity of informal competition holding other factors constant than compared with manufacturing firms.[13] In other words, service sector firms with larger market power tend to perform better with new product innovations with increases in informal competition as compared to manufacturing firms. This may also be due to the differences in non-competitive interactions with the informal sector. We find the indirect growth in sales mechanism to be most active in service sector as compared to manufacturing firms' in the face of informal competition.

Table 6 presents the regression results showing the effect of informal competition on domestic owned firms. Results reveal negative effect of informal competition on the performance of all product innovations introduced by firms owned locally. We failed to find any indirect mechanisms.

Regression results from our size of firm analyses are presented in Table 7 with panels A and B showing the basic and extended results for small-sized and medium-sized firms respectively. We find statistically negative effect of informal competition on both small and medium sized firms. We also find similar indirect mechanisms where medium-sized firms that experienced higher percentage sales from three fiscal years ago tend sell more of all product innovations with increases in the intensity of informal market competition holding other factors constant than otherwise. We however failed to find any evidence of similar indirect mechanisms for small-sized firms.

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[13] See Table 5 for results on the sectorial analyses.

Table 5: Sectorial analyses of the effect of informal product market competition on percentage sales from all product innovations.

	Manufacturing			Services and retail		
	(1)	(2)	(3)	(4)	(5)	(6)
	Percentage sales due to all product innovations					
Local informal competition (%)	-0.181***	-0.107	-0.382**	-0.234**	-0.274***	-0.885***
	(0.049)	(0.069)	(0.149)	(0.098)	(0.084)	(0.163)
Log of sales lagged 3 (USD)		-1.347*	-2.661**		-0.530	-2.623**
		(0.811)	(1.220)		(1.135)	(1.246)
Tax		-5.561	-4.769		1.378	1.933
		(6.617)	(6.733)		(6.217)	(5.126)
Corruption		-5.820**	-5.519*		-5.437**	-6.027**
		(2.901)	(3.017)		(2.535)	(2.939)
Licensing		2.934	2.843		6.994	7.673
		(2.040)	(1.990)		(5.124)	(5.035)
Crime		2.238	1.364		-9.408***	-9.840***
		(3.419)	(3.455)		(3.469)	(3.350)
Size of locality (250,000-1m)		-1.844	-0.374		-6.194	-2.934
		(2.967)	(3.080)		(4.105)	(4.431)
Size of locality (50,000-250,000)		-4.451	-2.998		-48.68***	-42.143***
		(6.176)	(6.575)		(9.934)	(9.560)
Size of locality (less than 50,000)		-26.584***	-27.404***		5.129	4.480
		(4.787)	(5.214)		(4.197)	(5.009)
IPMC* Corruption			-12.47**			1.339
			(6.043)			(8.510)
IPMC*Log of sales lagged (USD)			2.586*			5.468***
			(1.328)			(1.432)
Log of labour cost per worker		0.712	0.820		-1.785	-2.481**
		(1.062)	(1.078)		(1.216)	(1.015)
Log of total employment lagged		3.280	3.415		-2.112	-3.013
		(2.490)	(2.419)		(2.132)	(1.855)
Ownership		3.143	3.212		3.146	2.221
		(4.282)	(4.273)		(5.442)	(5.242)
Log of Experience		-5.475	-5.239		-4.481	-4.843
		(4.716)	(4.654)		(3.147)	(3.111)
Support		-1.802	-1.795		13.098	13.902*
		(7.673)	(6.716)		(8.353)	(7.121)
Log of Age		34.05***	35.42***		19.11*	18.46*
		(12.88)	(11.75)		(10.91)	(10.64)
Log of Age Squared		-5.725***	-6.151***		-4.271**	-4.174**
		(2.187)	(2.076)		(1.884)	(1.783)
Country$						
Ghana		-2.887	-1.945		-17.338***	-16.29***
		(3.633)	(4.023)		(4.009)	(4.472)
Tanzania		-8.223	-6.788		-2.120	0.477
		(6.103)	(6.639)		(8.176)	(6.846)
Uganda		-3.025	-4.459		-3.327	-4.603
		(4.074)	(4.090)		(4.234)	(3.927)
Zambia		-12.326	-17.009		0.678	-6.601
		(10.151)	(11.639)		(6.949)	(5.924)
	44.861***	17.241	32.009**	46.930***	107.908***	134.85***
Constant	(4.453)	(11.769)	(13.571)	(8.093)	(25.723)	(22.484)
N	**833**	**629**	**629**	**825**	**621**	**621**

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions include size, year and 23 industry dummies.

All coefficients and standard errors are robust to heteroskedasticity

$ Congo, Democratic Republic as base country

Table 6: Effect of informal product market competition on percentage sales from all product innovations of domestically owned firms.

	(1)	(2)	(3)
Percentage sales due to all product innovations			
Local informal competition (%)	-0.212***	-0.196***	-0.426***
	(0.067)	(0.055)	(0.149)
Log of sales lagged 3 (USD)		-1.553*	-2.421**
		(0.825)	(0.953)
Tax		1.693	1.952
		(4.910)	(4.685)
Corruption		-6.129***	-6.367***
		(1.897)	(1.947)
Licensing		4.226**	4.091**
		(1.832)	(1.831)
Crime		-1.447	-1.831
		(2.899)	(2.912)
Size of locality (250,000-1m)		-6.083**	-4.767
		(2.688)	(2.951)
Size of locality (50,000-250,000)		3.941	5.337
		(6.469)	(6.577)
Size of locality (less than 50,000)		-9.406***	-9.549***
		(3.309)	(3.427)
IPMC*Log of sales lagged 3 (USD)			0.019
			(0.013)
Log of labour cost per worker		0.187	0.115
		(0.930)	(0.942)
Log of total employment lagged		1.973	1.827
		(1.666)	(1.655)
Log of Experience		-4.352	-4.445
		(3.710)	(3.603)
Support		8.740	9.145
		(6.089)	(5.780)
Log of Age		23.992**	23.643**
		(11.490)	(11.380)
Log of Age Squared		-4.551**	-4.553**
		(2.093)	(2.062)
Country$			
Ghana		-11.682***	-11.041**
		(3.978)	(4.380)
Tanzania		-8.192	-6.842
		(5.556)	(5.927)
Uganda		0.271	-0.846
		(3.330)	(3.184)
Zambia		-6.919	-11.098*
		(5.242)	(6.513)
Constant	46.831***	56.945***	69.288***
	(5.943)	(10.907)	(14.095)
N	1351	1032	1032

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions include size, year, sector and 23 industry dummies.

All coefficients and standard errors are robust to heteroskedasticity

$ Congo, Democratic Republic as base country

Table 7: Effect of informal product market competition on percentage sales from all product innovations of small versus medium sized firms.

	Small		Medium		
	(1)	(2)	(3)	(4)	(5)
Percentage sales due to all product innovations					
Local informal competition (%)	-0.171***	-0.201***	-0.246**	-0.220*	-1.213***
	(0.065)	(0.071)	(0.108)	(0.127)	(0.222)
Log of sales lagged 3 (USD)		-0.834		-1.528	-5.085***
		(1.286)		(1.260)	(1.115)
Tax		-7.440		3.858	6.907
		(7.064)		(11.048)	(8.868)
Corruption		-7.105**		-2.989	-1.784
		(3.343)		(4.303)	(3.753)
Licensing		4.624		8.015	11.037**
		(3.251)		(5.577)	(5.198)
Crime		-2.425		1.652	-2.368
		(3.690)		(4.327)	(4.635)
Size of locality (250,000-1m)		-7.723**		-1.769	4.343
		(3.362)		(4.969)	(4.513)
Size of locality (50,000-250,000)		-8.308		-15.811**	-8.948
		(8.846)		(6.756)	(6.006)
Size of locality (less than 50,000)		-13.800*		-5.460	-6.153
		(8.293)		(7.074)	(7.284)
IPMC*Log of sales lagged (USD)					2.602***
					(1.759)
Log of labour cost per worker		-0.601		-1.239	-1.646
		(1.526)		(1.882)	(1.601)
Log of total employment lagged		-1.617		1.383	0.074
		(1.761)		(2.971)	(2.731)
Ownership		7.532		-3.518	-1.554
		(4.965)		(3.918)	(4.708)
Log of Experience		-4.421		-9.621**	-8.394**
		(4.082)		(4.158)	(4.054)
Support		14.440**		-3.675	5.244
		(6.442)		(13.167)	(9.672)
Log of Age		18.520*		30.740	33.585*
		(10.975)		(22.554)	(20.134)
Log of Age Squared		-3.245		-5.242	-5.985*
		(2.079)		(3.887)	(3.297)
Country$					
Ghana		-12.020**		8.783**	8.049**
		(4.869)		(4.186)	(3.211)
Tanzania		-12.105		1.672	-9.766
		(12.698)		(7.759)	(6.485)
Uganda		-2.313		10.287	-0.767
		(4.434)		(6.928)	(6.259)
Zambia		-7.839		18.900*	2.210
		(6.600)		(9.783)	(9.237)
Constant	44.888***	62.896***	46.238***	62.670	113.552***
	(5.588)	(13.676)	(8.792)	(42.122)	(39.576)
N	1084	829	446	333	333

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions include year, sector and 23 industry dummies. All coefficients and standard errors are robust to heteroskedasticity.

$ Congo, Democratic Republic as base country.

All estimations used local informal competition index (%) as instrument for Informal market competition. Firm size classifications are: Small >=5; <=19, Medium >=20 and <=99 and Large >=10

4.2 Extensions to industry-level informal competition

In extending the analyses to the industry-level[14], we followed the two-step econometric procedure presented above in equations 1 and 2 to construct industry-level informal product market competition indicator. The industry-level indicator is normalised between 0 and 1 with industries in a country having the least informal competition intensity assigned value zero while the industry with the highest informal competition intensity assigned the value 1. This enables us to capture the variations in the industry-level informal competition across different industries in the same country as well variations in similar industries across different countries.[15]

Table 8 presents the estimation results showing the effect of both our 'local' and industry-level informal competition indicators on the performance of product innovations. The sectorial analyses of the effect of 'local' and industry-level informal competition indicators are shown in Table 9. The results from both tables remain similar to the results obtained above with 'local' informal competition having significantly negative effect on the performance of product innovations in both manufacturing and service and retail firms. The results however indicate a significantly positive effect of industry-level informal competition across all specifications. This implies that, industries with higher concentration of informal firms tend to perform better on product markets with new product innovations. Sectorial analyses shown on Table 9 also indicates that, manufacturing firms tend to perform better on product markets with increases in industry-level informal competition than service and retail sector firms. This result may be explained by the differences in the technology gap and technical know-how between the manufacturing sector and informal manufacturing firms on one hand and between service and retail firms and informal service firms on the other. The service sector is relatively less capital intensive and requires less technical know-how compared with the manufacturing sector. As a result, informal firms are more likely to easily imitate and compete with new innovative services in an industry. This result is in line empirical findings by Blundell, Griffith & Van Reenen (1999), Aghion et al., (2001), Boldrin & Levine (2008).

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[14] See Appendix 5 for list of industries and industry classifications.

[15] See Appendix 6 for description of our industry-level informal competition indicator in percentages.

Table 8: Effect of 'local' and industry-level informal market competition on percentage sales from all product innovations.

	(1)	(2)	(3)	(4)	(5)
	Percentage sales due to all product innovation			**Total sales due to all product innovations ($)**	
Local informal competition (%)	-0.197***	-0.192***	-0.531***	-1.774**	-4.770***
	(0.074)	(0.066)	(0.136)	(0.827)	(1.624)
Industry informal competition (%)	0.215***	0.307***	0.320***	4.376***	4.489***
	(0.065)	(0.073)	(0.068)	(0.826)	(0.789)
Log of sales lagged 3 (USD)		-1.114	-2.509**	12.105	-0.172
		(0.821)	(1.035)	(11.934)	(14.704)
IPMC*Log of sales lagged 3 (USD)			0.028***		0.251*
			(0.011)		(0.149)
Tax		-2.144	-1.014	-2.582	7.326
		(4.020)	(3.877)	(47.575)	(47.753)
Corruption		-5.986***	-6.160***	-88.817***	-90.324***
		(2.241)	(2.351)	(31.834)	(33.005)
Licensing		5.578***	5.785***	83.103***	84.940***
		(1.795)	(1.752)	(22.230)	(22.047)
Crime		-2.488	-2.932	-65.979	-69.870
		(3.256)	(3.459)	(47.854)	(49.676)
Size of locality (250,000-1m)		-5.381**	-3.230	-56.755*	-37.913
		(2.492)	(2.492)	(33.977)	(35.338)
Size of locality (50,000-250,000)		-10.124**	-7.339	-187.161**	-162.867**
		(5.067)	(4.577)	(82.340)	(81.320)
Size of locality (less than 50,000)		-6.999**	-6.910*	-98.050***	-97.461***
		(3.105)	(3.622)	(30.459)	(34.866)
Log of labour cost per worker		-0.525	-0.700	-1.518	-3.069
		(0.842)	(0.816)	(11.300)	(11.155)
Log of total employment lagged		0.007	-0.295	5.990	3.162
		(1.849)	(1.721)	(26.780)	(25.657)
Ownership		3.734	3.651	82.558	81.929
		(3.436)	(3.392)	(57.017)	(56.697)
Log of Experience		-4.349**	-4.250**	-50.825***	-49.920***
		(1.806)	(1.719)	(18.219)	(18.237)
Support		8.195*	8.653**	108.748**	112.690**
		(4.793)	(4.293)	(53.681)	(48.994)
Log of Age		18.945**	18.854**	319.415***	318.385***
		(8.082)	(7.717)	(112.218)	(108.950)
Log of Age Squared		-3.550**	-3.613***	-63.027***	-63.552***
		(1.415)	(1.313)	(19.974)	(19.013)
Country$					
Ghana		-11.78***	-11.126***	-95.192***	-89.170**
		(3.416)	(4.061)	(31.279)	(37.087)
Tanzania		-2.934	-1.201	-6.703	9.123
		(5.591)	(5.943)	(60.147)	(67.259)
Uganda		-2.180	-3.517	-55.406	-67.397
		(3.717)	(3.406)	(44.774)	(43.602)
Zambia		-3.730	-8.121*	-81.568	-120.753**
		(4.202)	(4.253)	(52.443)	(58.969)
Constant	36.236***	54.531***	71.665***	105.879	258.117
	(6.985)	(11.045)	(14.635)	(164.267)	(202.933)
N	1655	1250	1250	1250	1250

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions include size, year and sector. All coefficients and standard errors are robust to heteroskedasticity.
$ Congo, Democratic Republic as base country.

Table 9: Sectorial analyses of the effect of 'local' and industry-level informal competition on percentage sales from all product innovations.

	Manufacturing			Services and retail		
	(1)	(2)	(3)	(4)	(5)	(6)
	Percentage sales due to all product innovation					
Local informal competition (%)	-0.164***	-0.094	-0.275*	-0.230**	-0.276***	-0.934***
	(0.051)	(0.084)	(0.166)	(0.097)	(0.086)	(0.152)
Industry informal competition (%)	0.253***	0.358***	0.365***	0.138	0.275*	0.256*
	(0.062)	(0.108)	(0.103)	(0.136)	(0.153)	(0.141)
Log of sales lagged 3 (USD)		-1.682**	-2.560**		-0.454	-2.714**
		(0.780)	(1.209)		(1.117)	(1.196)
IPMC*Log of sales lagged 3 (USD)			0.015			0.057***
			(0.014)			(0.014)
Tax		-5.128	-4.555		1.304	1.801
		(5.985)	(6.108)		(5.662)	(4.662)
Corruption		-4.976**	-4.764**		-5.929**	-6.346*
		(2.405)	(2.407)		(2.895)	(3.280)
Licensing		3.765	3.839		7.198	8.140*
		(2.998)	(2.927)		(4.973)	(4.911)
Crime		0.177	-0.256		-9.378***	-9.826***
		(4.294)	(4.403)		(3.420)	(3.319)
Size of locality (250,000-1m)		-2.467	-1.544		-5.334	-1.818
		(3.539)	(3.370)		(3.906)	(4.213)
Size of locality (50,000-250,000)		-5.589	-4.056		-48.484***	-40.657***
		(5.242)	(5.670)		(10.175)	(9.912)
Size of locality (less than 50,000)		-16.469**	-16.508**		1.968	0.389
		(6.830)	(7.408)		(2.631)	(3.084)
Log of labour cost per worker		0.448	0.526		-1.625	-2.415**
		(1.171)	(1.144)		(1.177)	(1.020)
Log of total employment lagged		1.828	1.957		-1.941	-3.018*
		(2.835)	(2.840)		(1.894)	(1.587)
Ownership		3.425	3.481		3.889	2.403
		(4.673)	(4.653)		(6.095)	(5.634)
Log of Experience		-4.827	-4.457		-3.600	-4.264
		(4.048)	(4.096)		(2.880)	(2.606)
Support		-1.254	-1.183		12.087	12.597*
		(8.382)	(7.874)		(8.033)	(6.607)
Log of Age		33.667***	33.736***		16.903	15.423
		(12.727)	(12.428)		(11.165)	(11.032)
Log of Age Squared		-5.949***	-6.039***		-3.924**	-3.647*
		(2.217)	(2.169)		(1.974)	(1.885)
Country$						
Ghana		-5.603	-5.406		-17.293***	-16.405***
		(7.067)	(7.500)		(3.301)	(3.661)
Tanzania		-3.945	-3.420		0.915	3.166
		(8.074)	(8.278)		(7.236)	(6.368)
Uganda		-2.327	-3.201		-4.537	-5.436
		(4.501)	(4.519)		(4.231)	(4.117)
Zambia		-9.991	-12.728		-1.366	-8.566
		(8.200)	(8.993)		(8.317)	(7.137)
Constant	30.976***	17.328	25.833	41.935***	106.116***	137.035***
	(4.914)	(14.137)	(17.659)	(9.538)	(20.790)	(17.648)
N	829	628	628	825	621	621

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions include size, year and sector. All coefficients and standard errors are robust to heteroskedasticity.
$ Congo, Democratic Republic as base country.

4.2 Robustness

To further test the robustness of our results to alternative empirical specifications, we followed Friesen & Wacker (2013) by employing our 'local' informal competition indicator as an instrument for informal competition. We also estimated this model on three (3) variants of sales from product innovations namely: percentage sales due to all product innovations, total sales due to all product innovations in dollars, log of total sales due to all product innovations in dollars. The results of all variant specifications as reported in Appendix 7 are consistent across all specifications with our earlier results with informal competition significantly affecting performance of product innovation negatively. That is, an increase in informal competition reduces the market performance of product innovations.[16]

5. Conclusion

Firm level evidence reveal the competitive behavior of informal firms as 'unhealthy' and one of the top three (3) obstacles formal businesses face in sub-Saharan Africa (Mendi & Costamagna, 2015; Ali & Najman, 2015; Friesen & Wacker, 2013; Lamanna & Gonzalez, 2007). The competitive interactions between firms in both sectors however continue to grow with increasing recognition of the 'permanent feature' of the informal sector particularly in sub-Saharan Africa (SSA). With limited empirical evidence assessing the economic implications of informal competitive behaviours on formal firms' performance, this paper fills the gap and contributes to the scant literature by examining the effect of informal product market competition on sales from all innovative products introduced by formal firms in SSA.

The World Bank's newly available Innovation Follow-Up Surveys were merged with the Enterprise Survey (ES) for five (5) SSA countries. Employing two econometric approaches that localize informal competition in the product market at the first level of estimation and controls for self-selection and sample selection biases at the second level of estimation, we have shown that 'local' informal competition matters for the performance of product innovations. That is, informality of the market tends to be detrimental to the performance of product innovations. We however found through interactions that, product innovations introduced by firms with larger market share tend to perform better with informality of the product market. That is, the main mechanism of increasing sales from product innovations is through growth in market size. We argued that, the indirect mechanism is driven mainly through the level of non-competitive interactions (collaborations and outsourcing of economic activities) between formal and informal firms. The collaboration and outsourcing of economic activities between the sectors we argued, enables registered firms to take strategic advantages of the 'local' market acceptance of informal firms to expand market size and perform better with product innovations. As a result, formal firms without or with less non-competitive interactions face intensive competition from 'informal' firms and hence lower sales of product innovations.

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[16] We also tested the stability of our results by introducing industry-level informal competition indicator as a second instrument for informal competition. We however found similar results.

In other words, formal firms with strategic 'footholds' in the informal sector thrive with product innovations.

Our findings provide useful evidence that point to the informal economy as a critical actor in the National System of Innovation (NIS) in sub-Saharan Africa. We recommend further research and policy debate on the role of informal firms in innovation systems.

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Table 10: Country data sample

Country	Year of ES	Year of IFS	Number of firms
Congo, D.R. (DRC)	2013	2013(2012-2010)	385
Ghana (GH)	2013	2013(2012-2010)	549
Tanzania (TZ)	2013	2013(2012-2010)	543
Uganda (UGA)	2013	2013(2012-2010)	449
Zambia (ZAM)	2013	2013(2012-2010)	540
TOTAL			**2,466**

Source: Computed from ES and Innovation Follow Up Surveys

Definition of variables

Product innovation: a binary variable taking the value of 1 if the firm has introduced product innovation over the last 3 fiscal years and 0 if otherwise.

Percentage sales from all product innovations: a continuous variable indicating the percentage of total sales represented by sales from all innovative products or services. It assumes strict value between 0-100. Zero implies the firm has not introduced product innovation.

Informal competition: binary classification that takes the value 1 if the firm considers the competitive practices of the informal sector as a major and a very severe obstacle and the value 0 otherwise.

Region: A categorical variable showing the twenty-two (22) country sampling regions.

Local informal competition indicator ($IPMC$): A continuous variable that indicates the local informal product market competition across regions of a country. It ranges between zero (0) and one (1) where values close to 1 indicate intense informal competition and values close to 0 indicating less informal competition in the vicinity.

Log of experience: the logarithm of the number of working years of the top manager.

Ownership: a dummy variable that takes value 1 if the firm is foreign owned and 0 if the firm is owned domestically.

Log of total employment (-3): the logarithm of total number of employees at end of 3 fiscal years ago.

Log of sales lagged (-3): the logarithm of total sales of output in last three (3) fiscal year converted to United States Dollars using exchange rate in corresponding fiscal year.

Log of labour cost per worker (USD) the logarithm of labour cost per worker in United States Dollars constructed as total cost of labour/total permanent employees+0.5(temporary employees) converted using exchange rate in last fiscal year.

Corruption: a dummy variable that assumes value 1 if the firm identifies corruption as a major constraint and 0 otherwise.

Tax: a dummy variable that assumes value 1 if the firm identifies tax rates as a major constraint and 0 otherwise.

Licensing: a dummy variable that assumes value 1 if the firm identifies the time to it takes to license as a major constraint and 0 otherwise.

Crime: a dummy variable that assumes value 1 if the firm identifies crime, theft and disorder as a major constraint and 0 otherwise.

Finance: a dummy variable that assumes value 1 if the firm identifies access/cost of finance as a major obstacle and 0 otherwise.

Labour regulations: a dummy variable that assumes value 1 if the firm identifies labour regulations as a major obstacle and 0 otherwise.

Locality: a categorical variable measuring the size of the locality with 0 if (<50,000), 1 if (>=50,000 and <=250,000), 2 if (>=250,000 and <=1 million) and 3 if large (1 million and over).

Marketing: a dummy variable that assumes value 1 if the firm used services of a marketing firm/ consumer research firm/ advertising firm and 0 otherwise.

Capital city: a dummy variable that assumes value 1 if the firm is located in the capital city and 0 otherwise.

Age: the number of years the firm has being operating.

Age square: the square of the number of years the firm has being operating.

Industry: sectors according to the group classification of ISIC Revision 3.1: group D, construction sector (group F), services sector (groups G and H), and transport, storage communications sector (group I) and IT (group K sub-sector 72).

Sector: a categorical variable that takes value 0 if the firm is engaged in manufacturing, 1 if firm is engaged in retail and 2 if firm is engaged in services.

Size of firm: a categorical variable that takes value 0 if the firm is micro (<5), 1 if the firm small (>=5 and <=19), 2 if the firm is medium (>=20 and <=99) and 3 if large (100 and over).

Support: a dummy variable that takes value 1 if the firm receives government support and 0 if otherwise.

Year: year of data collection.

Table 11: Probit estimation of informal competition as a major constraint

	Informal competition as a major constraint
Ownership	-0.054**
	(0.023)
Finance	0.113***
	(0.028)
Tax	0.055
	(0.059)
Corruption	0.040
	(0.029)
Licensing	0.081
	(0.049)
Crime	0.114**
	(0.046)
Labour regulations	-0.115
	(0.082)
Capital city	-0.265***
	(0.071)
Log of labour cost per worker	0.016
	(0.011)
Log of sales lagged 1 (USD)	-0.023**
	(0.010)
Log of Age	0.041
	(0.116)
Log of Age Squared	-0.006
	(0.026)
Log of Experience	0.004
	(0.024)
Size of locality dummy	Yes
Year dummy	Yes
Industry fixed effects	Yes
Region fixed effects	Yes
Country fixed effects	Yes
N	**1225**
Pseudo R2	0.1326

Standard errors in parentheses, $^*\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.
All coefficients and standard errors are robust to heteroskedasticity

APPENDIX 4

Table 12: Effect of informal product market competition on sales from all product innovations.

	(1)	(2)
	Percentage sales due to all product innovation	
Local informal competition (IPMC) (%)	-0.192***	-0.629***
	(0.057)	(0.123)
Marketing	6.357**	35.281***
	(3.236)	(5.303)
Marketing* Log of sales lagged 3 (USD)		-2.027***
		(0.357)
Log of sales lagged 3 (USD)	-1.161	-2.230**
	(0.876)	(0.934)
IPMC_ Log of sales lagged 3 (USD)		0.036***
		(0.010)
Tax	-2.154	-1.389
	(3.952)	(3.754)
Corruption	-7.531***	-7.773***
	(2.105)	(2.216)
Licensing	5.265***	4.817**
	(1.867)	(2.069)
Crime	-1.878	-2.498
	(2.916)	(2.964)
Size of locality (250,000-1m)	-4.631**	-2.613
	(2.262)	(2.275)
Size of locality (50,000-250,000)	-5.319	-6.050
	(5.001)	(5.016)
Size of locality (less than 50,000)	-12.262***	-16.120***
	(2.929)	(2.762)
Log of labour cost per worker	-0.518	-0.691
	(0.785)	(0.808)
Log of total employment lagged	0.781	1.202
	(1.738)	(1.558)
Ownership	3.440	2.443
	(3.430)	(3.375)
Log of Experience	-3.963**	-3.650**
	(1.943)	(1.767)
Support	7.825*	8.789**
	(4.613)	(4.170)
Log of Age	16.811*	15.293*
	(9.422)	(7.998)
Log of Age Squared	-3.163*	-3.018**
	(1.730)	(1.376)
Country$		
Ghana	-8.915***	-7.196**
	(2.733)	(2.946)
Tanzania	-4.126	-1.786
	(4.335)	(4.364)
Uganda	-1.511	-2.944
	(3.470)	(3.234)
Zambia	-3.461	-10.556*
	(5.587)	(6.264)
Constant	63.541***	73.917***
	(13.109)	(12.714)
N	1244	1244

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions include size, year, sector and 23 industry dummies. All coefficients and standard errors are robust to heteroskedasticity..

Table 13: ISIC Rev. 3

Industry of the firm	Frequency
Food	216
Textiles	67
Garments	121
Leather	10
Wood	72
Paper	7
Publishing, printing, and Recorded medi	96
Chemicals	67
Plastics & rubber	46
Non metallic mineral products	72
Basic metals	25
Fabricated metal products	160
Machinery and equipment	22
Electronics (31 & 32)	19
Transport machines (34&35)	8
Furniture	202
Construction Section F	60
Services of motor vehicles	110
Wholesale	148
Retail	488
Hotel and restaurants: section H	345
Transport Section I: (60-64)	71
IT	24
Total	2,456

Table 14: ISIC Rev. 3

Industry of the firm	Industry -level informal competition by Country				
	DRC	GH	UG A	TZ	ZAM
Food	59.202	59.202	59.202	59.202	59.202
Textiles	62.750	62.750	62.750	62.528	62.971
Garments	51.885	52.328	51.885	52.550	51.441
Leather	98.226	100	-	94.457	96.674
Wood	55.654	55.654	55.432	55.876	55.432
Paper	54.324	54.545	-	54.767	53.880
Publishing, printing, and Recorded medi	20.399	24.834	17.960	22.616	14.856
Chemicals	31.486	33.925	30.155	33.259	28.160
Plastics & rubber	52.106	52.550	52.106	52.772	51.663
Nonmetallic mineral products	44.789	45.676	44.346	45.676	43.459
Basic metals	52.106	52.328	51.885	52.550	51.441
Fabricated metal products	31.264	33.703	30.155	33.038	27.938
Machinery and equipment	8.647	-	4.656	11.086	0
Electronics (31 & 32)	-	83.370	82.262	80.931	82.927
Transport machines (34&35)	-	32.594	28.381	31.486	26.164
Furniture	56.984	56.984	56.984	56.984	56.763
Construction Section F	21.729	25.942	19.734	23.947	16.630
Services of motor vehicles	31.929	34.368	30.820	33.703	28.825
Wholesale	49.224	49.667	49.002	49.889	48.337
Retail	40.577	41.907	40.133	41.907	38.803
Hotel and restaurants: section H	27.273	30.377	25.721	29.268	23.282
Transport Section I: (60-64)	41.020	42.350	40.577	42.350	39.246
IT	50.111	50.554	49.889	50.776	49.446

Table 15: Effect of informal competition on sales from all product innovations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Percentage sales due to all product innovations			Total sales due to all product innovations		Log of total sales due to all product innovations	
Informal market competition£	-34.453***	-27.579**	-25.138*	-354.330***	-340.218**	-0.581***	-0.304***
	(9.173)	(13.817)	(15.171)	(136.070)	(146.955)	(0.089)	(0.114)
Log of sales lagged 3 (USD)		-1.344*	-0.974	9.788	13.094	0.0320	0.0359
		(0.747)	(0.932)	(10.594)	(12.896)	(0.0306)	(0.0364)
Tax		-2.327	-2.703	-18.499	-21.374	-0.0942	-0.129
		(4.022)	(4.147)	(51.943)	(53.582)	(0.156)	(0.195)
Corruption		-7.574***	-7.471***	-104.999***	-103.582***	0.0642	0.0143
		(2.341)	(2.352)	(35.676)	(35.996)	(0.141)	(0.172)
Licensing		6.319***	6.161***	87.996***	86.921***	0.220***	0.177*
		(1.916)	(1.810)	(23.453)	(22.066)	(0.0829)	(0.0936)
Crime		-3.104	-2.975	-71.489*	-71.481*	-0.285**	-0.211
		(2.983)	(2.990)	(41.850)	(41.249)	(0.134)	(0.142)
Size of locality (250,000-1m)		-2.625	-4.617	-30.961	-50.379	-0.170**	-0.107
		(3.022)	(3.172)	(31.189)	(34.987)	(0.0761)	(0.0763)
Size of locality (50,000-250,000)		-3.150	-5.112	-114.371	-133.270	-0.103	-0.0783
		(4.780)	(4.832)	(87.244)	(92.815)	(0.221)	(0.262)
Size of locality (less than 50,000)		-10.048***	-10.691***	-133.986***	-139.681***	-0.193	-0.323
		(2.879)	(2.836)	(33.891)	(35.965)	(0.238)	(0.794)
IPMC*Log of sales lagged (USD)			-0.006		-0.055	-0.0253*	-0.0118
			(0.005)		(0.082)	(0.0130)	(0.0144)
Log of labour cost per worker		-0.704	-0.537	0.213	1.418	-0.0210	0.0196
		(0.828)	(0.886)	(9.747)	(10.647)	(0.0248)	(0.0249)
Log of total employment lagged		1.903	1.946	26.434	26.765	0.0223	0.000659
		(1.803)	(1.786)	(24.598)	(24.263)	(0.0623)	(0.0700)
Ownership		4.810	5.031	93.956	96.719	0.246*	0.249*
		-0.704	-0.537	(59.654)	(59.231)	(0.144)	(0.143)

Log of Experience		-5.077**	-4.897**	-56.636**	-55.180**	-0.0682	-0.0822
		(2.251)	(2.137)	(23.467)	(21.755)	(0.0626)	(0.0879)
Support		8.574*	8.936*	104.484*	108.185*	0.222*	0.225
		(5.140)	(5.231)	(57.083)	(58.224)	(0.130)	(0.161)
Log of Age		17.674*	17.336*	295.346**	290.726**	0.251	0.480
		(10.201)	(10.060)	(125.738)	(124.475)	(0.323)	(0.346)
Log of Age Squared		-3.051*	-2.985*	-54.460**	-53.628**	-0.0470	-0.0936
		(1.810)	(1.796)	(23.613)	(23.570)	(0.0621)	(0.0699)
Country$							
Ghana		-7.183***	-8.566***	-53.158	-65.855*		0.0602
		(2.585)	(2.528)	(38.877)	(33.608)		(0.131)
Tanzania		-2.301	-4.588	-7.087	-27.330		0.317
		(4.438)	(5.317)	(44.026)	(56.142)		(0.254)
Uganda		-0.365	0.279	-47.848	-40.837		-0.208
		(5.759)	(5.274)	(54.129)	(51.739)		(0.137)
Zambia		-5.452	-3.596	-131.648*	-110.670*		-0.629**
		(7.893)	(7.341)	(67.939)	(61.003)		(0.252)
Constant	48.607***	61.531***	59.158***	291.304	277.457	6.387***	5.854***
	(6.673)	(15.798)	(16.286)	(200.856)	(208.746)	(0.566)	(0.834)
N	2374	2367	2367	2367	2367	2367	2367

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions include size, year, sector and 23 industry dummies.

All coefficients and standard errors are robust to heteroskedasticity

$ Congo, Democratic Republic as base country

£All estimations used local informal competition indicator (%) as instrument for Informal market competition.