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THE IMPACTS OF INFORMALITY ON ENTERPRISE INNOVATION, SURVIVAL AND PERFORMANCE: SOME EVIDENCE FROM PAKISTAN

SANA ULLAH

School of Economics, Quaid-i-Azam University Islamabad, Pakistan
sana_ullah133@yahoo.com

COLIN C WILLIAMS

Management School, University of Sheffield, Conduit Road, S10 1FL, United Kingdom
C.C.Williams@sheffield.ac.uk

BABUR WASIM ARIF

Department of Social Sciences, Iqra University, Islamabad, Pakistan
babur.wasim@iqraisb.edu.pk

The aim of this paper is to evaluate the relationship between informality, innovation and firm survival. To do so, a study of a cluster of electrical fittings firms in Pakistan is reported. Reporting bivariate and multivariate probit models to analyze two surveys conducted between 2008 and 2017, the finding is that there is a significant relationship between informality and the extent of innovation, firm survival and firm performance. Informality has an adverse negative effect on firm-level innovation, firm survival and firm performance. Given that formal enterprises in this cluster are better performing in terms of innovation, survival and employment growth than informal businesses, the paper concludes by discussing the theoretical, policy and research implications.

Keywords: industrial cluster; informal economy; informal sector; entrepreneurship; firm survival; firm performance; innovation; Pakistan.

1. Introduction

Across the world, some two-thirds of all enterprises have been estimated to be unregistered at start-up (Autio and Fu, 2015), at least half of all enterprises globally are estimated to be operating on an unregistered basis (Acs et al., 2013), and an even higher proportion operating in the informal sector if one includes formal enterprises not declaring a portion of their turnover (Williams, 2018). The result has been the advent of a new stream of entrepreneurship scholarship focused upon informal sector entrepreneurship, which refers to starting-up and/or owning and managing a business venture which does not register with and/or declare some or all of its production and/or sales to the authorities for tax, benefit

and/or labor law purposes when it should do so (Chepurenko, 2018; Kahn, 2017; Ketchen et al., 2014; Siqueira et al., 2016; Williams, 2017; Williams and Martinez-Perez, 2014a,b; Williams and Shahid, 2016; Williams et al., 2015, 2017).

Within this emergent literature on informal sector entrepreneurship, a "poorer performance" thesis has predominated. This argues that enterprises operating in the informal sector are poorer performing relative to enterprises operating in the formal sector. Until now, however, the evidence-base to support this thesis has been very thin (Farrell, 2004; La Porta and Schleifer, 2008, 2014; Palmer, 2007). In consequence, the aim of this paper is to evaluate this poorer performance thesis by providing some case study evidence from the electrical fittings sector in Pakistan on whether enterprises operating in the informal sector are less innovative, have lower survival rates and are poorer performing than formal sector enterprises.

To do this, section 2 reviews the literature on the relationship between informality and innovation, survival and firm performance and in doing so, formulates hypotheses to test the poorer performance thesis. Section 3 then reports the empirical evidence used to evaluate these hypotheses, namely two surveys conducted in 2008 and 2017 of the electrical fittings sector in Pakistan and the impacts of non-registration on innovation, survival and performance. Section 4 then reports the results followed in section

2. Informality and enterprise innovation, survival and performance: review and hypotheses development

Since the turn of the millennium, a new stream of entrepreneurship scholarship has emerged that focuses upon entrepreneurship in the informal sector (for an early overview, see Williams and Nadin, 2010). This literature has not only drawn attention to the prevalence of informal entrepreneurship (Autio and Fu, 2015; Ram et al., 2017; Webb et al., 2013; Welter et al., 2014; Williams, 2006, 2015, 2018; Williams and Kedir, 2016, 2017; Williams and Youssef, 2013) but also analyzed why the participation of entrepreneurs in the informal economy is more prevalent in some countries and global regions than others (Dau and Cuervo-Cazurra, 2014; Siqueira et al., 2014; Thai and Turkina, 2014), the characteristics of entrepreneurs operating in the informal sector (Williams and Horodnic, 2018; Williams and Shahid, 2016) and the motives of informal entrepreneurs, such as whether they operate informally out of necessity or choice (Maloney, 2004; Perry and Maloney, 2007; Williams et al., 2012).

A small sub-stream of this scholarship on entrepreneurship in the informal sector has focused its attention on the impacts of informality on the performance of enterprises. The predominant belief has been that the result of operating in the informal sector is the poorer performance of enterprises (Farrell, 2004; La Porta and Schleifer, 2008, 2014; Palmer, 2007; Vandenberg, 2005).

The seminal scholarship that is continuously cited to support this "poorer performance" thesis is the study La Porta and Schleifer (2008: 344) which concludes that "Productivity is much higher in small formal firms than in informal firms, and it rises rapidly with the size of formal firms". To reach this conclusion, World Bank Informal Surveys are analyzed

in 13 countries and World Bank Micro-Enterprise Surveys in 14 countries (19 in Africa, six in Asia and two in Latin America). Examining the number of enterprises surveyed, the average Informal Survey involved 31 registered and 192 unregistered firms, and the average Micro-Enterprise Survey involved 137 registered and 77 unregistered enterprises. Therefore, these results are based on a total sample of 2,321 registered enterprises and 3,574 unregistered enterprises. Moreover, the sampling procedure used in each country was non-representative in that "World Bank contractors identified neighborhoods perceived to have a large number of informal firms" (La Porta and Shleifer, 2008: 295). Using this small non-representative sample, La Porta and Schleifer (2008) identify statistically significant variations in the performance of registered and unregistered enterprises in 10 of the 25 countries surveyed on value added per employee at the 0.1 level (and four countries at the 0.01 level), 17 of the 26 countries on sales per employee at the 0.1 level (and 12 at the 0.01 level), and in 18 of the 26 countries on output per employee at the 0.1 level (12 at the 0.01 level). Hence, their finding is that there are not significant variations in firm performance between informal and formal enterprises in every country. It is not universal. Indeed, registered enterprises are outperformed by unregistered enterprises in six of the 25 countries on value added per employee, three of the 26 countries on sales per employee and four of the 26 on output per employee (see La Porta and Shleifer, 2008: Tables 13 and 14). Moreover, a crucial point that is often missed by scholars citing this study is that the authors explicitly state (albeit in a footnote) that the poorer performance of unregistered enterprises is not the case and "unregistered firms are not unusually unproductive once we take into account their expenditure on inputs, the human capital of their top managers, and their small size" (La Porta and Shleifer, 2008: 335).

Other evidence, albeit similarly weak, of the poorer performance thesis exists in other studies (Fajnzylber et al., 2009; Farrell, 2004; McKinsey Global Institute, 2003). For example, Fajnzylber et al. (2009) find that Mexican enterprises paying taxes exhibit between 15-60% higher "productivity" levels, although the measure of productivity used is profit levels and self-employment income, and they fail to control for the full range of enterprise-level determinants that influence performance.

The poorer performance thesis is also asserted to exist when comparing formal enterprises that start-up on an unregistered basis and enterprises registered from the outset of operations. Perry et al (2007: 173) report World Bank survey data on 355 unregistered start-ups across seven Latin American countries (104 in Colombia, 72 in Argentina, 72 in Bolivia, 66 in Mexico, 20 in Peru, 12 in Uruguay and nine in Panama) and conclude that unregistered start-ups "at least initially, exhibit on average, much lower levels of output per worker, after controlling for firm size, time in business, sector and region". However, this is again based on a very small sample of enterprises, the gap in performance between unregistered and registered start-ups is only statistically significant in four of the seven countries surveyed and the headline average national figure that unregistered start-ups have 29% lower productivity is heavily biased by the Peru data on 20 unregistered start-ups where the performance gap is over 50%.

Therefore, there is a strong consensus about the poorer performance of informal enterprises but a weak evidence-base. To try to correct this, there have been recent analyses of more extensive datasets. Analyzing the performance of unregistered start-ups compared with enterprises registered from the outset, various studies of both individual countries (e.g., India, South Africa) and cross-nationally find that non-registration at start-up leads to higher levels of subsequent firm performance (Williams and Bezeredi, 2018; Williams and Kedir, 2016, 2017a,b, 2018a,b,c). This is claimed to be because enterprises that initially avoid the cost of registration and focus their resources on overcoming other liabilities of newness, lay a stronger foundation for subsequent growth than those registered from the outset (Williams et al., 2017).

However, all these studies compare only enterprises unregistered at start-up with enterprises registered from the outset. They do not compare enterprises operating in the informal sector with enterprises operating in the formal sector. As such, the following hypothesis can be tested:

> Poorer performance hypothesis (H1): Enterprises operating in the informal sector are more likely to witness poorer firm performance than enterprises operating in the formal sector.

All the above studies only analyze the comparative performance of informal and formal enterprises in terms of their levels of annual sales, employment and/or productivity growth. They do not compare the level of innovation in informal and formal enterprises. In recent years, however, it has been recognized not only that firm performance is often associated with the level of technological innovation (Mansury and Love, 2008) but also that there is a lower level of innovation and adoption of new technologies in informal enterprises, and that which does take place in informal enterprises is more adaptation and imitation (Wunsch-Vincent et al., 2015). Until now, however, the evidence-base is very thin. A study of the African countries found that formal firms had significantly higher levels of innovation (Fu et al., 2017). Indeed, it has been suggested that the level of innovation is a direct product of its level of formality (Mendi and Mudida, 2017). However, few, if any, studies have evaluated the comparative level of innovation in formal and informal enterprises. Instead, much which is asserted is assumption rather than empirical-based findings (Williams, 2015). As such, the following hypothesis can be tested:

> Lower innovation hypothesis (H2): Enterprises operating in the informal sector are less likely to engage in innovation than enterprises operating in the formal sector.

Furthermore, few, if any, studies have analyzed firm survival rates among formal and informal enterprises. The notion of liabilities of newness (Stinchcombe, 1965) has been a core component of venture creation for over half a century. There is a recognition that new ventures have lower survival rates than older more established ventures (Barron et al., 1994; Wiklund et al, 2010). It is asserted that this is because new ventures do not have a

track record on which they can base their claims of legitimacy, reliability, and accountability (Choi and Shepherd, 2005; Delmar and Shane, 2004) and be seen as competent, effective, and worthy (Zimmerman and Zeitz, 2002). Registration is therefore one way of enhancing legitimacy because registration intimates that an enterprise complies with the laws and regulations (Kistruck et al., 2015; Webb et al., 2009), suggesting stability, quality and/or prestige (Bitekine, 2011; Suchman, 1995). Conversely, non-registration results in a perceived lack of legitimacy which negatively affects nascent firm performance (Farrell, 2004; Fajnzylber et al., 2009; ILO, 2007; La Porta & Schleifer, 2008; Palmer, 2008). As Fagerberg et al. (2010) argue, the level of formality plays a significant role in the probability of firm survival, mostly at the firm and industry level. Firm survival is realized as a learning process in which firms able to adopt formality and innovation grow and survive, while firms that do not decline and fail (Fu et al., 2017). The strong suggestion, therefore, is that registered enterprises should have higher survival rates than unregistered enterprises. Until now, however, no known studies have evaluated the impact of operating in the informal sector on survival rates. Therefore, the following hypothesis can be tested:

> Poorer survival rate hypothesis (H3): Enterprises operating in the informal sector have a poorer survival rate than enterprises operating in the formal sector.

3. Data, Variables and Analytical Method

3.1. Data

To evaluate the relationship between informality and enterprise innovation, survival and growth, data is here reported from enterprise surveys conducted in Pakistan in 2008 of 232 entrepreneurs producing electrical fittings in the Sargodha cluster (see Arif and Sonobe, 2012) and a follow-up study conducted in 2017 of 254 enterprises in the same sector and geographical area.

In each period, all enterprises in this Sargodha geographical area were interviewed who operate in the electrical fittings sector. Although all firms in the cluster were surveyed, some were registered and others not. The government has only information on a few register firms in this geographical area and sector, and based on this information, the full range of enterprises cannot be identified. Therefore, the interviewers not only identified on foot the full range of businesses operating in this area in the electrical fittings sector but also used details from the chairperson of Bakelite is provide details of the enterprises as well as a snowballing technique when interviewing enterprises. This method was applied in both the 2008 and 2017 surveys. In 2008, 232 enterprises were identified. For the 2017 surveys, those in existence in 2008 were visited again. During the 2017 surveys, 254 enterprises were identified. The number of enterprises had therefore grown.

3.2. Variables

3.2.1. Dependent variables

Three dependent variables are analyzed, namely innovation, firm survival and firm performance. Firstly, high, low and zero innovation is defined using three criteria, namely: self-die making; plastic production, and direct marketing with one's own brand name. In general, these three measurements of innovation belong to product, process and marketing innovations respectively, and refer to whether they have occurred in the last three-year period in both the 2008 and 2017 surveys. High innovation is a dummy variable which equals 1 if the entrepreneurs introduced a minimum of two or three of these conditions (self-die making, plastic production, and direct marketing with their own brand name) or 0 otherwise. Similarly, low innovation takes a value of 1 if one innovation condition has been introduced and 0 otherwise. No innovation takes the value 1 if the firm has introduced none of these three innovations in the last three years and 0 otherwise.

Firm survival is a binary variable that takes the value 1 if the firm survived between 2008 to 2017 in the cluster and 0 otherwise. Firm performance is a continuous variable that measures the employment growth rate of the surviving firm between 2008 and 2017.

3.2.2. Independent variable

Regarding the independent variable, namely informality, this is a dummy variable that takes the value 1 if the enterprise operates informally or has not registered its operations under any authority, or 0 otherwise. This s consistent with previous studies by Wellalage and Locke (2016) and Mendi and Mudida (2017) and wider definitions of informality. It defines non-registration and also self-reporting of informal trading as indicators that an enterprise operates in the informal sector.

3.2.3. Control variables

It is important also in econometric specifications to hold a number of control variables constant when analyzing the relationship between the dependent variables and the independent variable. To do so, a group of general and specific human capital, social capital and firm characteristic control variables are incorporated into the regression which previous studies have revealed are associated with innovation, firm survival and firm performance (e.g., Williams et al., 2017). These are:
- Owner's years in education – a continuous variable of the number of years of formal education of the entrepreneur.
- Production experience – a dummy variable equal to 1 if the entrepreneur has prior production experience in the same industry and 0 otherwise.
- Marketing experience – a dummy variable equal to 1 if the entrepreneur has prior marketing experience in the same industry and 0 otherwise.
- Skilled employees – a continuous variable of the number of employees with production specialization or high school education.

- Father in high-income occupation – a dummy variable equal to 1 if the entrepreneur's father belongs to a high-income group and 0 otherwise.
- Relatives in same business – a dummy variable equal to 1 if the entrepreneur had prior to starting relatives in the same industry and 0 otherwise.
- Friends in same business – a dummy variable equal to 1 if the entrepreneur had prior to starting friends in the same industry and 0 otherwise.
- Fathers in same business – a dummy variable equal to 1 if the entrepreneur had prior to starting their father in the same industry and 0 otherwise.
- Ethnic majority – a dummy variable equal to 1 if the entrepreneur belongs to the ethnic majority group and 0 otherwise.
- Birth place in Sargodha – a dummy variable equal to 1 if the entrepreneur is born in Sargodha and 0 otherwise.
- Credit constraints – a dummy variable equal to 1 if entrepreneur fulfills a minimum of one or more than one condition (i.e., applied for a loan but rejected by the bank; high transaction cost; inadequate collateral; don't know procedure for applying for a loan; religious issues), and 0 otherwise.
- Source of finance friends and relatives – a dummy variable equal to 1 if the entrepreneur used friends and relatives as source of financing in last 3 years and 0 otherwise
- Source of finance traders – a dummy variable equal to 1 if the entrepreneur used traders as source of financing in last 3 years and 0, if otherwise.
- Year of operation - Average total years of operation.
- Owner age - Average total years of owner age.
- Firm size - Average size of firm (Total number of production employees, and number of mangers).
- Marketing channels - Average number of marketing channels (Retailers, traders, sales agents, and own shop).
- Manufacturing with trading - Equal to 1 if the entrepreneur is manufacturing with own trading activity and 0, if otherwise.

3.3. Model *specification*

To analyze the relationship between informality and innovation, performance and survival, a structural equations model was applied that recognizes the endogeneity of informality (i.e., that an informal firm based on certain characteristics of the entrepreneurs and the enterprises, and the role of informal activity as a determinant of innovation). Therefore, the first equation captures the informality function. The model is

$$IF_i = \beta_i X_i + \mu_i \tag{1}$$

Where IF_i as an observable informality binary variable, and X_i is a vector of variables, including the firm owner's social and human capital, entrepreneurial expertise, and firm characteristics, β is a vector of parameters of interest, and μ_i is an error term. In order to test our innovation hypothesis, we expand the basic model in three directions to capture the different nature of innovations on the basis of informality. So, we decompose the

innovation activity into high innovation ($HInn_i$), low innovation ($LInn_i$), and no innovation ($NInn_i$). The model is

$$HInn_i = \beta_0 + \beta_i IF_i + \beta_i X_i + \epsilon_{1i} \tag{2}$$

$$LInn_i = \beta_0 + \beta_i IF_i + \beta_i X_i + \epsilon_{2i} \tag{3}$$

$$NInn_i = \beta_0 + \beta_i IF_i + \beta_i X_i + \epsilon_{3i} \tag{4}$$

Where three innovation variables are dummy, X_i is a vector of variables of innovation, and ϵ_{ni} is an error term. The measure of productivity is widely used in informality studies to capture firm's performance (Fu et al., 2017; and Mendi and Mudida, 2017). The rationale is that formal firms have higher productivity. Wilde (2000) considers a four equation probit model in which the errors are correlated and the binary dependent variable of the first equation is an endogenous variable in the second, third and fourth equation. This model is an extension of recursive bivariate probit model. In our estimation, we take care of the endogeneity of IF_i by using the recursive multivariate probit models in the estimation of Equation (1) to (4). We assume there is an endogeneity problem. A set of equations 1 to 4 can be estimated using a recursive multivariate probit model approach through a jointly simulated maximum likelihood approach (Capellari and Jenkins, 2003). The model has a similar structure of a multivariate probit model, except that the endogenous variables are included in model.

A test of the endogeneity of the variable is based on the correlation Corr (μ_i, ϵ_{1i}) of the error term μ_i in the informality equation with the error term ϵ_{1i} in high innovation Equation (2). If Corr(μ_i, ϵ_{1i})=0, Equation (1) for informality is independent of the high innovation equation, and the null hypothesis of no endogeneity is accepted. If Corr(μ_i, ϵ_{1i})≠0, the null hypothesis is rejected, and the variable for informality is considered as endogenous. The similar issue arises in equation 3 and 4 to check the error term there is correlation with equation 1. Similar tests can be performed in other equations. So the recursive multivariate probit model is here preferred as it takes the endogeneity into account.

To examine the impact of informality on firm survival, meanwhile, we estimate equation (1) and (5) jointly through a recursive bivariate probit model. The model is

$$S_i = \beta_0 + \beta_i IF_i + \beta_i X_i + \nu_i \tag{5}$$

where S_i represents the firm survival and it is binary dummy variable in model. Where IF_i is a binary independent, and X_i is a vector of control variables, and μ_i is an error term. Using a cluster dataset, we explore how firm informality influences firm survival using this recursive bivariate probit model.

4. Results

4.1. Descriptive statistics

Table 1 reports the descriptive findings of the 2008 survey of 232 enterprises and 2017 survey of 254 enterprises. In 2008, 75 per cent of enterprises operated informally and in 2017, 60 per cent of enterprises did so. The level of informalisation in the electrical fittings cluster of firms in this geographical area has therefore slightly diminished over time but remains high, reflecting similar levels of informality to the wider Pakistan economy (Williams and Schneider, 2016).

Table 1: Descriptive statistics of electoral fittings sector enterprises, Sargodha, Pakistan

	Formal	**Informal**	**Formal**	**Informal**
	2008	**2008**	**2017**	**2017**
Count	57	175	104	150
(%)	25.00	75.00	40.00	60.00
High innovation	0.32	0.12	0.71	0.38
Low innovation	0.59	0.33	0.19	0.29
No innovation	0.09	0.55	0.10	0.33
Firm survival			0.77	0.55
Growth rate			1.38	0.76
Credit constraints	0.37	0.78	0.40	0.49
SOF_FRs	0.07	0.29	0.26	0.28
SOF_traders	0.05	0.22	0.03	0.31
Father in high-income occupation	0.65	0.29	0.41	0.19
Owner schooling	8.95	7.28	8.57	6.82
Year of operation	13.49	7.55	15.52	9.79
Production experience	0.47	0.75	0.62	0.85
Marketing experience	0.07	0.01	0.37	0.47
Skilled employees	2.26	0.48	4.13	2.14
Relatives in same business	0.54	0.33	0.62	0.66
Friends in same business	0.30	0.24	0.54	0.79
Fathers in same business	0.07	0.03	0.11	0.15
Ethnic majority	0.23	0.29	0.32	0.31
Birth place in Sargodha	0.74	0.93	0.82	0.72
Owner age	44.02	38.74	42.34	40.53
Firm size	20.26	7.07	21.16	12.00
Marketing channels	3.01	1.58	4.22	2.83
Manufacturing with trading	0.68	0.30	0.66	0.44

Comparing the descriptive statistics on the relationship between innovation and informality, the finding is that 71 per cent of formal enterprises display a high level of innovation in 2017 compared with 38 per cent of informal enterprises (reflecting a similar pattern to 2008). This reinforces previous studies conducted in Kenya (Mendi and Mudida, 2017) and Ghana (Fu et al., 2017). Conversely, 33 per cent of informal enterprises display no innovation compared with just 10 per cent of formal enterprises. Therefore, formal enterprises display higher levels of innovation than informal enterprises.

Turning to survival probability and firm performance (measured in terms of employment growth from 2008 to 2017), these descriptive findings reveal that the firm

survival rate is lower among informal enterprises. Some 77 per cent of formal enterprises survived between 2008 and 2017 but only 55 per cent of informal enterprises. Examining firm performance, measured in terms of employment growth rates, these too tend to be higher in formal enterprises compared with informal enterprises. Formal enterprises witnessed a 138 per cent employment growth rate between 2008 and 2017 whilst for informal enterprises this figure was 76 per cent. Therefore, compared with informal enterprises, formal enterprises tend to have higher survival rates and grow faster than informal ones.

Briefly examining some of the control variables, it is interesting to note that compared with informal enterprises, formal enterprises are less likely to suffer credit constraints, are older than informal enterprises, and to be larger than informal enterprises. Informal entrepreneurs, meanwhile, tend to be younger than formal entrepreneurs, to have production and marketing experience, and are more likely to be working without a brand name or trade mark.

4.2. Informality and innovation

To see if these descriptive findings regarding the relationship between informality and enterprise innovation remains when other variables are held constant, Table 2 reports the results of a recursive multivariate probit model which simultaneously estimates four equations where the errors are acceptable to be correlated. The results are taken from both the 2008 and 2017 surveys. Model 1 reveals the correlations between informality and the socio-demographic, socio-economic and firm-level characteristics of the entrepreneurs and enterprises surveyed. Models 2, 3 and 4 then address the impact of informality on high innovation, low innovation, and zero innovations respectively.

The first finding from the 2008 survey is that the significant correlations identified in model 1 between informality and the socio-demographic, socio-economic and firm-level characteristics of the entrepreneurs and enterprises hold constant in the other models in Table 2. These are that informal entrepreneurs are significantly more likely to have lower levels of education, and for their business to have been in operation for few years than their formal counterparts and are more likely to be from an ethnic minority group and to have been born in Sargodha, to operate smaller enterprises, and are less likely to have a diversity of marketing channels.

Turning to the relationship between informality and innovation in 2008, the finding in model 2 of Table 2 is that informal enterprises are significantly less likely to display high innovation levels, which is here measured to repeat by whether the enterprise has introduced at least two of the following conditions (self-die making, plastic production and direct marketing under their own brand name). Therefore, informality has a significant negative impact on high levels of innovation. Moreover, the endogeneity test results show that $\text{Corr}(\mu_i, \epsilon_{ni}) \neq 0$, which implies that the null hypotheses of endogeneity is rejected in models 1 and 2. This finding is consistent with earlier studies of enterprises in Ethiopia, Ghana, and Kenya (Gebreeyesus, 2009; Robson et al., 2009, and Mendi and Mudida, 2017). Formal firms are more likely to engage in high innovation activities. Hence,

hypothesis 2 is confirmed that enterprises operating in the informal sector are less likely to engage in innovation than enterprises operating in the formal sector. Informality is negatively correlated with both high and low innovation and there is a significant positive relationship between informality and zero innovation.

Table 2: Informality and Firm Innovation, 2008

Variables	Informality	High innovation	Low innovation	No innovation
	(1)	(2)	(3)	(4)
Informality		-1.050***	-0.687*	1.014**
		(0.403)	(0.389)	(0.511)
Owner schooling	-0.061*	0.074*	0.026	-0.177***
	(0.036)	(0.040)	(0.038)	(0.056)
Year of operation	-0.037*	0.042**	0.038*	-0.062*
	(0.020)	(0.021)	(0.021)	(0.034)
Production experience	0.017	0.261	0.324	-0.047
	(0.278)	(0.288)	(0.289)	(0.382)
Marketing experience	-0.020	0.825	0.629	-1.167
	(0.707)	(1.008)	(0.747)	(0.849)
Skilled employees	-0.076	0.185*	-0.179*	-0.115
	(0.119)	(0.108)	(0.105)	(0.156)
Relatives in same business	-0.034	0.091	-0.004	0.393
	(0.265)	(0.256)	(0.277)	(0.354)
Friends in same business	0.290	0.177	0.249	-0.276
	(0.288)	(0.285)	(0.280)	(0.366)
Fathers in same business	-0.599	1.105**	-0.657*	-2.170*
	(0.399)	(0.503)	(0.381)	(1.257)
Ethnic majority	0.935***	0.110	0.273	0.092
	(0.325)	(0.284)	(0.296)	(0.366)
Birth place in Sargodha	1.087***	0.559*	1.074***	-0.492
	(0.336)	(0.316)	(0.407)	(0.577)
Father in high-income occupation	-0.249	-0.151	0.373	-0.633
	(0.289)	(0.309)	(0.287)	(0.392)
Owner age	-0.004	0.003	-0.002	-0.015
	(0.015)	(0.016)	(0.015)	(0.021)
Firm size	-0.072***	0.052***	-0.134***	-0.049*
	(0.022)	(0.018)	(0.026)	(0.028)
Marketing channels	-0.793***	0.420***	0.449***	-0.387**
	(0.181)	(0.156)	(0.167)	(0.196)
Manufacturing with trading	-0.438*	0.452*	2.294***	-2.855***
	(0.261)	(0.285)	(0.317)	(0.462)
Constant	2.192***	-3.531***	-1.683*	3.551***
	(0.765)	(0.986)	(0.969)	(1.300)
Correlation coefficients:				
rho12: informality ×high innovation		0.627***		
		(0.091)		
rho13: informality ×low innovation		0.291*		
		(0.161)		
Rho14: informality × no innovation		-0.308**		
		(0.121)		
rho23: high innovation ×low innovation		-0.249		
		(0.172)		
Rho24: high innovation × no innovation		-0.185		
		(0.141)		
rho34: low innovation× no innovation		0.229**		
		(0.130)		

Likelihood ratio test		38.02***	
Wald chi2(63)		269.67***	
Observations		232	

Notes: The innovation results are taken from bivariate recursive probit in models 1 and 2. Heteroskedasticity robust standard errors are in parentheses. Significance of coefficients at the 10%, 5%, and 1% levels are shown by *, **, and ***, respectively.

Turning to the relationship between informality and innovation in 2017, the finding in model 2 of Table 3 is that informal enterprises are significantly less likely to engage in high innovation. Informality negatively and significantly effects on high innovation. Meanwhile, informality is positively and significantly associated with low and zero innovation. Again, this confirms hypothesis 2 that enterprises operating in the informal sector are less likely to engage in innovation than enterprises operating in the formal sector, although low innovation is in 2017 positively rather than negatively associated with informality.

Table 3: Informality and Firm Innovation, 2017

Variables	Informality	High innovation	Low innovation	No innovation
	(1)	(2)	(3)	(4)
Informality		-1.191***	0.908***	0.644*
		(0.452)	(0.284)	(0.352)
Owner schooling	-0.053*	0.067*	-0.056*	-0.078**
	(0.030)	(0.035)	(0.028)	(0.035)
Year of operation	-0.036**	0.045**	-0.034*	-0.044**
	(0.018)	(0.021)	(0.018)	(0.022)
Production experience	0.551**	0.701**	0.312	-0.414
	(0.250)	(0.348)	(0.275)	(0.347)
Marketing experience	-0.247	0.779**	0.842***	-0.466
	(0.298)	(0.371)	(0.279)	(0.345)
Skilled employees	-0.061	0.403***	-0.207**	-0.105
	(0.087)	(0.142)	(0.101)	(0.093)
Relatives in same business	0.055	-0.038	-0.110	-0.247
	(0.237)	(0.301)	(0.228)	(0.273)
Friends in same business	-0.247	0.377	-0.040	-0.232
	(0.258)	(0.322)	(0.246)	(0.293)
Fathers in same business	-0.197	0.804**	-0.569*	-0.676*
	(0.328)	(0.402)	(0.330)	(0.365)
Ethnic majority	0.083	0.201	-0.159	0.059
	(0.226)	(0.296)	(0.216)	(0.273)
Birth place in Sargodha	0.117	0.128	-0.042	-0.189
	(0.267)	(0.359)	(0.244)	(0.288)
Father in high-income occupation	-0.137	0.653**	0.049	0.069
	(0.255)	(0.304)	(0.254)	(0.333)
Owner age	-0.025*	0.019	0.010	-0.023
	(0.013)	(0.017)	(0.012)	(0.016)
Firm size	-0.027*	0.037*	-0.038*	-0.033*
	(0.015)	(0.022)	(0.020)	(0.018)
Marketing channels	-0.623***	0.705***	0.196*	-0.625***
	(0.112)	(0.215)	(0.106)	(0.124)
Manufacturing with trading	-0.466*	0.880**	1.329***	-0.815***
	(0.262)	(0.374)	(0.278)	(0.312)
Constant	3.208***	-2.107*	-2.299***	3.489***
	(0.710)	(1.154)	(0.688)	(0.927)

Correlation coefficients:	
rho12: informality ×high innovation	0.673*** (0.065)
rho13: informality ×low innovation	-0.251** (0.120)
Rho14: informality × no innovation	-0.278* (0.162)
rho23: high innovation ×low innovation	-0.280*** (0.107)
rho24: high innovation × no innovation	-0.148 (0.130)
rho34: low innovation× no innovation	0.043 (0.126)
Likelihood ratio test	68.06***
Wald chi2(63)	283.74***
Observations	254

Notes: The innovation results are taken from bivariate recursive probit in models 1 and 2. Heteroskedasticity robust standard errors are in parentheses. Significance of coefficients at the 10%, 5%, and 1% levels are shown by *, **, and ***, respectively.

Regarding the control variables, the entrepreneurs' education, years they have been operating, and number of skilled employees are linked with high innovation. The owners' level of education has a positive impact on low innovation and a skilled labor force is negatively associated with low innovation. In other words, the coefficient of the owner's level of education, years they have been operating and skilled labor force variables are positive and statistically significant, thus indicating that non-innovative entrepreneurs are usually uneducated and their employees unskilled. This reinforces previous studies by Nam et al. (2010) in Vietnam and Bradley et al. (2012) in Kenya, where firms in which human capital was less skilled constrained innovation. Furthermore, the coefficient of having a parent in the same business is positive and significant with high innovation and negatively impacts on low and zero innovation across all the models. Social capital provides opportunities to entrepreneurs for personal ties that increase the likelihood that the entrepreneurs would be exposed to new ideas (Robson et al., 2009). This result also implies that social networks acquired through relatives, friends, and traders are advantageous for innovation. A similar effect is found from a previous study in Ethiopia (Gebreeyesus and Mohnen, 2013). Finally, firm size, number of marketing channels, and manufacturing seem to be a driver of high innovation. This implies that large firms have more information on marketing and get innovation through knowledge from the traders' markets. This is again in line with the previous literature (Gebreeyesus and Mohnen, 2013; Protogerou et al., 2017).

4.3. Informality, firm survival and employment growth

Table 4 presents regression results for the relationship between informality and firm survival and firm performance measured by employment growth. Model 1 shows the effect of informality on firm survival. It reveals that enterprises operating in the informal sector have a poorer survival rate than enterprises operating in the formal sector. This confirms hypothesis 3. No known research has been previously conducted which reveals this strong

significant positive relationship between formality and firm survival. Moreover, the endogeneity results show that the null hypothesis of no endogeneity is rejected in model 1. Turning to the control variables significantly associated with firm survival, model 2 in Table 4 reveals that human capital, entrepreneurs schooling, prior production experience and the years in operation has a positive statistically significant effect on firm survival. The coefficients of ethnic majority and birth place in Sargodha are also statistically significant. This reinforces previous studies that firm survival is positively associated with social capital (Colombelli et al., 2013; Morikawa, 2013).

Table 4: Informality, firm survival and employment growth, 2008-2017

	1		2	
	Recursive bivariate probit		**Endogenous treatment model**	
	Firm survival	**informality**	**Firm growth**	**informality**
Variables	**(1)**	**(2)**	**(3)**	**(4)**
Informality	-1.902***		-4.674**	
	(0.183)		(2.321)	
Owner schooling	0.045*	-0.052*	-0.233***	-0.045*
	(0.024)	(0.030)	(0.077)	(0.025)
Year of operation	0.026**	-0.039**	-0.110**	-0.037*
	(0.013)	(0.017)	(0.044)	(0.022)
Production experience	0.432**	-0.051	-0.213	0.404
	(0.211)	(0.257)	(0.642)	(0.320)
Marketing experience	0.242	-0.162	-2.402*	-1.005
	(0.333)	(0.369)	(1.326)	(0.900)
Skilled employees	0.015	-0.0449	0.067	-0.0705
	(0.017)	(0.057)	(0.064)	(0.087)
Relatives in same business	0.148	-0.162	-0.843*	0.101
	(0.180)	(0.219)	(0.476)	(0.325)
Friends in same business	0.191	0.437	0.092	-0.404
	(0.200)	(0.268)	(0.623)	(0.329)
Fathers in same business	0.392	-0.343	-1.130	-0.438
	(0.477)	(0.490)	(1.475)	(0.843)
Ethnic majority	0.350*	0.915***	0.180	0.114
	(0.202)	(0.265)	(0.611)	(0.343)
Birth place in Sargodha	0.479*	1.144***	-0.459	0.791*
	(0.275)	(0.287)	(0.931)	(0.472)
Father in high-income occupation	0.061	-0.355	-0.375	0.204
	(0.203)	(0.263)	(0.604)	(0.331)
Owner age	-0.005	-0.013	-0.028	-0.034**
	(0.011)	(0.015)	(0.034)	(0.017)
Marketing channels	0.183*	-0.645***	-0.307	-0.477***
	(0.106)	(0.148)	(0.394)	(0.184)
Manufacturing with trading	0.435**	-0.421*	1.348*	-0.142
	(0.206)	(0.243)	(0.776)	(0.435)
Constant	1.402**	2.392***	9.752***	2.937***
	(0.590)	(0.828)	(3.272)	(0.980)
Rho12	13.817***			
	(1.26)			
Inverse Mills ratio			2.85**	
			(1.36)	
Wald test	118.78***			
Observations	232	232	140	140

Notes: Firm survival results are taken from bivariate recursive probit in model 1 and employment growth results are taken from linear endogenous treatment-regression in model 2. Heteroskedasticity robust standard errors are

in parentheses. Significance of coefficients at the 10%, 5%, and 1% levels are shown by *, **, and ***, respectively.

Model 3 shows the effect of informality on firm performance, measured in terms of employment growth. Enterprises operating in the informal sector are more likely to witness poorer firm performance than enterprises operating in the formal sector. This confirms hypothesis 1. Informality has a significant negative impact on employment growth. However, inverse Mills' ratio is significant in model 3, which indicates the existence of selectivity bias and the necessity to use a linear endogenous treatment model. This implies that informal enterprises tend to grow slower than their formal counterparts, confirming the previous findings in Aftab and Rahim (1989) and Williams et al. (2017). We find also evidence that formality enhances a firm's capability to grow and survive. This is probably because of fact shown in model 4 that informal entrepreneurs tend to have lower levels of education and experience.

5. Discussion and Conclusions

In this study, firm-level data has been reported gathered in surveys of electrical fittings enterprises in the Sargodha area of Pakistan in 2008 and 2017, to advance understanding of the relationship between informality and firm innovation, survival and growth. This has revealed that there is a strong significant association between informality and firm-level innovation, survival and performance. Enterprises operating in the informal sector are significantly more likely to witness poorer firm performance than enterprises operating in the formal sector (confirming H1). They are also significantly less likely to engage in innovation than enterprises operating in the formal sector (confirming H2) and are significantly less likely to survive than formal enterprises (confirming H3). These findings from the electrical fittings sector in the Sargodha area of Pakistan have wider theoretical and policy implications.

This paper advances theoretical understandings of informal sector entrepreneurship in three ways. Firstly, these findings advance understanding of the relationship between informality and firm performance. Previous studies reveal that enterprises starting-up unregistered are significantly more likely to have higher levels of firm performance than enterprises registered from the outset. This is because by avoiding the cost of registration, they focus their resources on overcoming other liabilities of newness and lay a stronger foundation for subsequent growth than those who register from the outset (Williams et al., 2017). However, the current study is one of the first to compare enterprises operating in the informal sector with enterprises operating in the formal sector. The important finding is that enterprises operating in the informal sector are more likely to witness poorer firm performance, measured in terms of employment growth, than enterprises operating in the formal sector. Secondly, although it has been intimated that the level of innovation is lower in informal enterprises (Mendi and Mudida, 2017), few, if any, studies have evaluated the comparative level of innovation in formal and informal enterprises. This study reveals that that it is indeed the case that enterprises operating in the informal sector are less likely to

engage in innovation than enterprises operating in the formal sector. And third and finally, no known have evaluated the relationship between survival rates and informality. This study reveals for the first time, so far as is known, that informal enterprises have lower survival rates than formal enterprises.

These findings have policy implications. It reveals that for economic development and growth to be pursued, there is a need to formalize the informal economy. Unless these informal sector enterprises are moved into the formal sector, and formalization is moved towards, then firm-level innovation will remain lower, as will firm survival and growth. Therefore, formalization of the informal sector is a necessity to engender higher levels of innovation, firm survival and to improve firm performance. This has implications for Pakistan's Vision 2030 which sets the goal of improving innovation and productivity. This can only be achieved by working towards the formalization of the informal sector. How this can be achieved has been clearly previously set out by the International Labour Organization in Recommendation 204 (ILO, 2016).

Despite these advances in understanding the relationship between informality and firm innovation, survival and growth, there are nevertheless limitations to this study. On the one hand, and most importantly, this is a study of one sector in one geographical area of Pakistan. Similar studies now need to be conducted in other sectors and other geographical areas, countries and global regions to evaluate whether similar findings are replicated. On the other hand, in these future studies, it would also be useful to use more conditions when examining firstly, innovation and secondly, firm performance (e.g., sales growth).

In sum, this paper has advanced understanding of the relationship between informality and firm innovation, survival and growth, displaying that informal sector enterprises have lower levels of innovation, survival and employment growth than formal sector enterprises in the electrical fittings sector in the Sardogha area of Pakistan. If this study now stimulates studies in other sectors and places, countries and global regions to explore whether this is more widely the case, then one of the major intentions of this paper will have been achieved. If this then leads to governments giving more consideration to the formalization of informal enterprise when forging policy on innovation, survival and employment growth, then its wider intention will have been fulfilled.

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