Working Paper Series

#2019-002

Do young innovative companies create more jobs? Evidence from Pakistani textile firms

Waqar Wadho, Micheline Goedhuys and Azam Chaudhry

Maastricht Economic and social Research institute on Innovation and Technology (UNU-MERIT)
email: info@merit.unu.edu | website: http://www.merit.unu.edu

Boschstraat 24, 6211 AX Maastricht, The Netherlands
Tel: (31) (43) 388 44 00

UNU-MERIT Working Papers
ISSN 1871-9872

Maastricht Economic and social Research Institute on Innovation and Technology UNU-MERIT

UNU-MERIT Working Papers intend to disseminate preliminary results of research carried out at UNU-MERIT to stimulate discussion on the issues raised.

Do young innovative companies create more jobs? Evidence from Pakistani textile firms

Waqar Wadho[a] Micheline Goedhuys[b] Azam Chaudhry[c]

Abstract

Using unique innovation survey data collected among a homogenous sample of firms active in the textiles and apparel sector in Pakistan, this paper analyses the role of innovation for employment growth. In particular, it develops and tests the hypothesis that innovation is conducive to employment creation, and that this is especially the case for smaller and younger firms, supporting the hypothesis that young innovative companies grow faster by engaging in riskier and more radical innovation to catch up with incumbent firms. We find empirical evidence for these hypotheses, which is robust to different model specifications and estimation techniques and to different measures of innovation. Young innovative companies also perform well in absolute employment creation making them interesting from a policy perspective.

Keywords: Technological innovation, Firm growth, Employment growth, Quantile regression Textiles, Pakistan

JEL: L25, L26, L67, O30, O53

[a] Lahore School of Economics, Barki Road, Lahore Pakistan. w.wadho@lahoreschool.edu.pk
[b] United Nations University (UNU-MERIT), Boschstraat 24, 6211 AX Maastricht, the Netherlands, Corresponding author:Goedhuys@merit.unu.edu
[c]Lahore School of Economics, Barki Road, Lahore Pakistan. azam@lahoreschool.edu.pk

1. Introduction

Firm growth is an important dynamic underlying the process of structural change in developing countries. The transition of a firm from smaller to larger size typically involves technological upgrading towards higher value added activities and the exploitation of economies of scale. In the process, growing firms generate employment opportunities for the young labour force that enters the labour market in vast numbers in developing countries. For these reasons, policy makers in developing countries have shown a keen interest in understanding the determinants of entrepreneurship and the post-entry performance of firms (Quatraro & Vivarelli, 2015) and in creating the conditions for firm growth. However, recent evidence from a wide range of countries has indicated that job creation is highly unevenly distributed across firms and that the majority of job creation can be attributed to only a very small number of fast growing firms, termed 'high-growth firms' or 'gazelles' in the literature (Delmar et al., 2003; OECD, 2007). This sparked academic interest in investigating the distinguishing features of fast growing firms and policy interest in how to better support (the emergence of) these businesses (Maula et al., 2007).

The traditional firm growth literature provides rich theoretical and empirical evidence that younger and smaller firms grow faster than older and larger firms (Jovanovic, 1982; Evans, 1987; Coad, 2009; Quatraro & Vivarelli, 2015). Also, an important strand of the literature has found that innovation is the key driver of productivity of firms and the engine of sustained firm growth (Pakes & Ericson, 1998; Audretsch et al., 2014). More recently, and mainly in the search of explanations for more extreme growth performance, the focus of attention has been on the combinations or interactions of firm-level size-age-innovation characteristics. This stems from the observation that it is not the individual characteristics but rather a combination of several characteristics that explains firm growth, especially extreme growth performance. In particular, the age of a firm seems to have a moderating role on the relationship between innovation and firm growth. While older established incumbents can more easily build on existing routines and capabilities allowing them to innovate more effectively, they may be hampered by organisational inertia (Coad et al., 2016). New entrants by contrast, aspiring to obtain a better position in the market, may be more likely to invest in R&D and riskier activities and undertake more radical innovations (Audretsch et al., 2014) leading to higher growth. An emerging avenue of research

conceptualises ‘Young Innovative Companies (YICs)’, defined as firms that combine smallness, newness and high R&D intensity (Czarnitzky & Delanote, 2013; Schneider & Veugelers, 2010) or newness and innovation (Pellegrino et al., 2011), and found them to exhibit superior average innovation and growth performance, making them an appropriate focus for designing public policies. Alternative approaches using quantile regression techniques also found innovation to be a strong predictor for the emergence of high-growth firms, especially in combination with young age (Coad and Rao, 2008, Coad et al., 2016).
The investigation of these interaction effects is nevertheless still quite recent in the literature, largely biased towards more high tech or technology-based industries and covering mainly European countries. In a survey paper, Moreno and Coad (2015) call for broadening the scope of these studies to include low tech industries and developing countries, where the study of firm growth for development and employment generation is particularly relevant. But the literature on innovation in developing countries generally describes the innovation process as being more incremental and less radical in nature and being based on mastering embodied technology developed elsewhere (Zanello et al., 2016), a process that is closely related to the development of technological capabilities to catch up with frontier technologies (Abramovitz, 1986; Bell and Pavitt, 1992; Lall, 1992; Kim, 2000). Considering this type of innovation, multiple questions arise: first, does innovation significantly boost firm growth and, second, are innovative new ventures more successful than incumbents in turning innovation efforts into employment creation and sales growth.

This paper responds to this call by investigating the role of innovation, in interaction with size and age, for the employment growth of firms active in the textiles and apparel industry in Pakistan. We first define YICs as firms being small, young and innovative, using cut-offs that align with the particular context of the textiles industry in Pakistan and we test whether they exhibit superior growth. We test the sensitivity of the results for different size thresholds and different innovation measures used for defining a YIC. Next we complement the analysis with a quantile regression estimation and test whether our focal variables – size, age and innovation and combinations thereof– have different impacts on different quantiles of the conditional growth distribution. We explore in greater depth the mechanisms that may underlie our findings and extend our analysis (i) by investigating the role of YICs for absolute employment creation and (ii) testing the robustness of the findings when sales growth is used as a size growth measure.

For the analysis we use the data of a unique innovation survey, which we conducted in 2015 on a stratified random sample of textiles and apparels manufacturers in twelve districts of Pakistan. In the case of Pakistan, like that of many developing countries, there are no detailed firm level innovation data available. This paper is among the first works with a focus on innovation in Pakistan using the micro data. The data we use are similar to the ones used in Wadho and Chaudhry (2018), who analyse a firm's decision to engage in innovation as well as product innovation intensity and its further impact on labour productivity. The result from this study complement the findings of Wadho and Chaudhry by providing evidence on innovation and its impact on the size of firms measured by employment and sales growth.

The textile and apparel industry of Pakistan is an interesting case in a number of ways: First, sectors like textiles are often the 'leading sectors' because as countries begin to industrialise, these sectors require relatively less investment in terms of physical and human capital (Rostow, 1978). Second, textiles have experienced tremendous growth in recent years. World exports of textiles and clothing increased from $482 billion in 2005 to $797 billion in 2014. This, coupled with increasing wages in China, the leading textile exporting country, provides tremendous scope for countries like Pakistan to increase its share in world textile exports. Third, textiles is one of the few success stories in the Pakistani manufacturing sector and contributes significantly to the local economy, with one-fourth of industrial value added, employing about 40 percent of industrial labour force in Pakistan and constituting 55-60 percent of national exports.[1] Fourth, being very labour intensive, textiles have the potential to contribute to wider social changes by providing employment opportunities for the growing labour force, including the young, women and low-skilled workers.

Our paper contributes to the literature in many ways. The paper addresses the drivers of firm growth and high growth of firms, broadening the industrial organisation with insights from a particular developing country, Pakistan. Pakistan is representative for a larger region, which is severely understudied in the literature on enterprise development. Second, it contributes to the

[1] Economic Survey of Pakistan 2015–2016.

literature on innovation and entrepreneurship. It focuses on the role played by young innovative companies in comparison to larger established innovators, providing insights that connect to the innovation and entrepreneurship policy debates on whether targeting of firms is desirable and if so, whether targeted support should be channelled to established firms or to new innovative ventures. Third it contributes to the innovation and development literature, as it sheds light on the type of innovation activities that are most important for growth performance. By using different proxies for innovation, this study provides a better understanding on the role played by technological innovation versus in-house R&D in the superior growth performance of small and young companies. Finally, the study is conducted using a data source that provides a more homogenous sample than is usually obtained from innovation surveys.

Our findings show that innovation plays a major role in developing country firms' post-entry performance and that YICs demonstrate superior employment creation. Even though innovation in developing countries is generally described as incremental in nature and closely related to the development of technological capabilities to catch up with frontier technologies, we do observe differences between YICs and more established older and larger firms in the way innovation translates into growth. This supports the idea that riskier and more radical innovation activities are conducted more effectively in innovative new ventures than in larger incumbent firms. The findings are also supported by the various definitions and specifications we apply. YICs appear indeed more intensively engaged in innovation activities and introduce more radical innovations, explaining their superior employment creation, also in absolute employment generation. Using sales growth instead of employment growth a largely similar picture emerges.

The paper is structured as follows. Section two discusses related literature and develops the hypothesis for empirical testing. Section three presents the data and the estimation strategy, including the model and variable construction. Section four presents the results and discusses the findings of the analysis. Section five discusses the absolute employment creation and tests the robustness of the findings to a sales growth indicator. Section six concludes.

2. Related literature

2.1. Firm size, age and growth

The study of firm growth took off with the pioneering work of Gibrat (1931) who argued that firm growth is fundamentally unpredictable. Gibrats 'Law of Proportionate Effect (LPE)', describes growth in its most extreme *random* form and was very influential in leading scholars to investigate growth more intensively. Rather than being a random process, theoretical models by Lucas (1978) and Jovanovic (1982) argue that growth results from a *Bayesian learning* process. The argument is that prospective entrepreneurs enter the industry without a-priori knowledge about their own efficiency level. Once established, they discover in competition with the market their own level of efficiency. The more efficient firms adjust the scale of operations accordingly and grow into the larger size that corresponds with their efficiency level, while less efficient firms remain small or are forced to exit. As this process of discovery takes place during the first years after entry, substantial size adjustments are more prominent among young firms. Models of passive learning therefore provide a theoretical basis for explaining what many empirical studies found: that young firms exhibit higher growth rates than older firms (see Coad 2009, for a review of these studies).

Considering firm size, in industries where economies of scale are prominent, firms operating on a smaller scale experience cost disadvantages compared to larger competitors. Small firms will invest more heavily to expand their operations quickly to close the gap. The negative size-growth relationship is especially evident for the smallest firms, which grow more rapidly to reach the 'Minimum Efficient Scale (MES)' (Caves, 1998; Audretsch, 1995; Teruel, 2010).

Inspired by the empirical model of Evans (1987) that relates firm growth to size and age, many studies generated systematic evidence in support of a negative size-growth and age-growth relationship, which led to the being recognised as 'stylised' facts (Coad, 2009). These relationships have also been tested and confirmed for developing countries, mainly using data from African firms (McPherson, 1996; Goedhuys & Sleuwaegen, 1999; Sleuwaegen & Goedhuys, 2002; Bigsten & Gebreeyesus, 2007; Arouri et al., 2018). However, the findings for developing countries show that though small firms grow faster, for the smallest starters these growth rates flatten out quickly (Sleuwaegen & Goedhuys, 2002; Bigsten & Gebreeyesus, 2007; Arouri et al., 2018, Nichter and Goldmark, 2009). This finding is consistent with so-called ‘necessity’ or ‘survival’ entrepreneurs entering the market with a limited set of capabilities, endowments and ambitions, which limits their growth. With vast number of entrepreneurs entering the market every year, more is needed than size and age criteria to identify firms with growth potential.

2.2. Innovation and firm growth

Various models from different theoretical traditions have considered the role of innovation for growth (Schumpeter, 1942; Nelson & Winter, 1982; Ericson & Pakes, 1995; Aghion & Howitt, 1992). Overall, these models find that innovativeness increases productivity, through market expansion or cost reduction, leading to growth. But the empirical link between innovation and firm growth at the micro level is not straightforward and depends on the type of innovation considered eg. product vs. process innovation.

Product innovation is intended to make firms more competitive through quality advantages (Bogliacino & Pianta, 2010) thereby stimulating market expansion and expanding both sales and employment (Pianta & Antonucci, 2002). Process innovations by contrast improve the efficiency and quality of the production process often with cost cutting effects, potentially leading to the lay-off of workers. Therefore, the effect of process innovation on sales growth is generally positive, but the impact on employment growth may be smaller or (temporarily) negative if process innovations intend to be labour-saving and cost-reducing.

Various empirical studies indeed establish a positive relationship between R&D or innovation and firm growth (Roper, 1997; Yasuda, 2005). Using quantile regression techniques, others find this relationship to hold for the high growth of firms (Coad and Rao 2008) including in developing countries (Goedhuys and Sleuwaegen, 2010; Santi and Santoreli, 2017), although the developing country evidence is more mixed (Goedhuys et al., 2008 and 2014).

2.3. Interaction effects between size, age and innovation

The literature has also focused on the combination of several of these factors to explain firm growth. In particular age shows up as a moderating factor affecting the relationship between innovation and firm growth. This discussion dates back to Schumpeter (1934) who on the one hand characterised a system as ‘creative destruction’ when new firms introduce innovations to the market to put pressure on incumbent firms (so-called Schumpeter Mark I), and on the other hand defined systems of "creative accumulation" when incumbent firms were more prone to introduce innovations into the market (so-called Mark II, Schumpeter, 1942). Both frameworks seem to co-exist in industry (Audretsch et al., 2014; Pellegrino et al., 2011).

When it comes to innovation older firms may have advantages over younger firms as they have built up routines, capabilities and accumulated resources that help them respond to technological opportunities. Over time, firms gain managerial knowledge, learn to deal with uncertainty and develop a reputation and a market position that facilitates the introduction of innovations (Coad et al., 2016). But incumbent firms may also be characterised by organisational inertia that constrains the firms' ability to expand and grow, limiting the benefits innovation can bring (Majumdar, 1997).

For younger firms, opposing effects have been identified. Young firms start without established routines and capabilities and must build them rapidly upon entry. Hence young firms may initially lack the internal capabilities that are needed to benefit from R&D investments. However, they assess how their performance relates in comparison to their competitors and how it can be improved. If the performance of entrants is below that of existing firms they need to catch-up in order to be competitive (Audretsch et al., 2014).

This has implications for the type of innovation and the nature of the innovation process that firms conduct. Young firms aspiring to obtain a larger market share might be more prone to invest in R&D and to introduce radical innovations to improve their market position relative to their counterparts. In a similar way, Baumol (2002), Vaona and Pianta (2008) argued that firms concerned with safeguarding existing skills or their market position are less inclined to introduce radical innovations.

To test how age interacts with innovation for firm growth, researchers have categorised and labelled different types of firms such as 'New Technology-Based Firms (NTBF)', a combination of young and innovative firms and working in high tech sectors (Little, 1977). More recently the attention has shifted to 'Young Innovative Companies (YICs)'. A YIC is defined as a firm that is young, small, and intensively engaged in innovation activities[2]. An emerging literature on YICs has found them to exhibit superior growth and innovation performance (Czarnitzky & Delanote,

[2] For example, by the European Union definition, these companies are less than 6 years old, have fewer than 250 employees, and they have an R&D intensity larger than 15% as measured by R&D spending relative to total operating expenses.

2013; Schneider & Veugelers, 2010; Santarelli & Tran, 2017). Alternatively, using quantile regression Coad et al., (2016) found that age interacts with innovation as young firms undertake riskier innovation activities which may have greater performance benefits if successful.

2.4. Innovation in developing countries

Most of the existing literature tends to recognise that innovation in developing countries generally differs from the innovation in developed countries in that diffusion and incremental change account for most of the innovation occurring in developing countries (OECD, 2005; Zanello et al., 2016; Wadho & Chaudhry, 2018). In the developing countries' context, the term 'innovation' has been used to describe changes that are new to the local context, even if they have no or negligible contribution to the global knowledge frontier. But imitative innovation can also add considerable value. The idea of considering imitators as innovators is in line with the observation by Hall (1994) who suggested that the distinction between Schmookler's innovator and the imitating enterprises is often unclear (Schmookler, 1966). Imitating enterprises, in their process of implementation, often do things differently from the way they were done by the first enterprise (be it by design or unintentionally), which makes them innovators in their own way.

Also the innovation activities leading to innovation outcomes differ in developing countries. Performing R&D might not be the dominant strategy for the introduction of innovations, as firms generally generate technological advances outside formal R&D processes (Wadho & Chaudhry, 2018). Imitation and embodied technology acquisition may be more important than R&D for firms in developing countries attempting to catch up (Grossman & Helpman 1991; Bell & Pavitt, 1992; Coe & Helpman, 1995). Moreover, importing foreign technology alone does not facilitate innovation (Li, 2011) and the beneficial role of international technology diffusion is shown to depend on parallel indigenous innovation efforts and the presence of modern institutional and governance structures and conducive innovation systems (Fu et al., 2011). In this respect the concept of "capabilities" has received attention as a key factor to explain why countries and firms succeed or not in catching up. "Social capabilities" – societal characteristics allowing to make a technological leap (Abramovitz, 1986), "technological capabilities" - efforts and activities that individual enterprises undertake to absorb knowledge and build upon existing knowledge necessary for efficient production (Kim, 1980 and 1997; Romijn, 1997, Lall, 1992; Bell & Albu, 1999; Figueiredo, 2003), and "absorptive capacity" - the ability to absorb external knowledge coming from other firms and scientific institutions such as universities and research labs (Cohen & Levintal, 1990; Rosenberg, 1990) are key preliminary factors for firms to engage in innovation, imitation and absorption of externally developed technologies.

Hypotheses

Considering the previous discussion, we expect that innovation in developing countries, even imitative, incremental innovation that involves mastery of externally developed technology, will positively influence firm growth. In particular, we expect technological innovation to spur employment growth, even though labour-saving process innovations may partly offset the positive effect. We also expect young and small firms to grow faster, following a process of learning and catching up with larger competitors, as documented in the literature.

We are particularly interested in exploring whether the higher growth that is found for young innovative firms also exists when the innovations are taking place in a low tech industry in a developing country. It remains an open question whether younger versus older firms will benefit more from their innovative activity. If young innovative companies have higher growth, this point to the benefits of young firms being more flexible to respond to technological opportunities and new market trends and engaging in innovations that are more radical than the innovations that are conducted by incumbent firms. The competing hypothesis would indicate that routines, resources and endowments enable older incumbents to benefit more from innovation, in a creative accumulation regime. The next section explores this question empirically with data from Pakistani textile firms.

3 .Methodology and variables

3.1. Survey design

In 2015, we conducted an innovation survey among textile and wearing apparel manufacturers in Pakistan following the OECD's Oslo Manual Guidelines for Collecting and Interpreting Innovation Data (OECD, 2005). The Manual has become the international standard for conducting innovation surveys and provides a comprehensive and widely used survey design. The manual and its methodology has been very influential, leading to a harmonised Community

Innovation Survey conducted in 27 European countries[3], while also being increasingly used in developing countries including in Latin America, South-East Asia and more recently Africa (UNESCO, 2017).

For an overview of the innovation performance of the manufacturing sector, the Oslo manual (OECD, 2005) recommends stratified random sampling based on firm size, sector of activity and geographic location of firms. We focused our study on the textiles and apparel sector, so we only sampled firms that are classified under sections 13 and 14 of the Pakistan Standard Industrial Classification, PSIC 2010 (International Standard Industrial Classification— ISIC 17 and 18).

Based on the information provided in the Directory of Industries[4], 96 percent of textiles and wearing apparel manufacturers of Pakistan are located in two provinces, Punjab and Sindh. We used the Directory of Industries in both provinces as the main sampling frame. All registered firms with a minimum 10 employees are included in the frame. However, the directories were not updated and they required significant work to create a useable version. The sampling frame was then cleaned/updated with the support of the Bureaus of Statistics of Sindh and Punjab. This process of updating involved cross comparing information with the Pakistani Ministry of Textiles, various Chambers of Commerce and Industry, the All Pakistan Textiles Mills Association (APTMA), the Pakistan Readymade Garments Manufacturers and Exporters Association (PRGMEA), and the Karachi Stock Exchange (KSE). The directories only provided the names and locations of the companies, which did not allow us to further stratify the sample. The final sample frame included 4,205 textiles and wearing apparel manufacturers in Punjab and Sindh provinces, 62 percent being in Punjab and 38 percent in Sindh.

We were confined to stratify our sample based on the geographic location of firms, first at the provincial level and then at the district/regional level. Given the limitations of the sample frame, and especially the lacking information on firm size, we randomly selected firms within the location strata in order to obtain a representative sample for the industry. We targeted a random sample of 614 firms, representing about 15 percent of the sampling frame, for face-to-face interviews with a knowledgeable person designated by firms at the level of manager or above. Interviews were conducted by well-trained officials of the bureaus of statistics of Punjab and

[3] https://ec.europa.eu/eurostat/web/microdata/community-innovation-survey

[4] Official business register of the provincial Bureaus of Statistics of Punjab, Sindh, Khyber Pakhtunkhwa and Baluchistan.

Sindh. A total of 431 out of 614 firms eventually participated in the survey, which represents a survey response rate of 70 percent. Despite our efforts to update the sample frame, the majority of non-respondents (139 firms out of a total 183 non-respondents) were firms who did not exist or were permanently closed at the time of survey.[5]

Of the 431 respondents, 54 firms refused to report their annual turnover due to confidentiality issues. We had to exclude these firms from the statistical analyses, leaving us with a final working sample size of 377 firms. To investigate if this non-response could have created a systematic bias in our analysis Appendix-A table A1 reports summary statistics of key variables for these two samples (431 and 377 firms). It shows that the two samples are comparable and that the final sample should not yield biased results. Our working sample of 377 firms contains 32 percent of firms from Sindh and 68 percent from Punjab, closely reflecting the distribution of the sample frame.

The survey questionnaire was also designed on the basis of the Oslo manual (OECD, 2005) and its recommendations for developing countries. In this approach, innovation input is broadly defined as an “investment in formal R&D and innovation related non-R&D activities such as the acquisition of machinery, hardware and software, purchase/licensing of patents, workers' training related to innovations”. Innovation output is defined as “the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations” (OECD, 2005). The survey was conducted in August-October 2015 and innovation related questions were for the previous three fiscal years, 2013–2015.[6] Appendix-B provides more details on innovation related questions, survey implementation and post implementation quality control protocols.

The data are cross sectional, but they have the advantage that they are from a very homogenous set of firms from the textile and apparel sectors, generating a sufficiently rich data set to get a representative picture on innovation in the textiles sector; in many ways this sample is better than

---

[5] Our repeated interaction with the bureaus of statistics revealed that the missing firms generally are those firms that are permanently closed but are not updated in the directory of industries, the firms who are registered in official documents but have no actual business, and the firms who are registered with more than one name. The first type of missing firms was due to the frame which is not periodically updated or at least not completely updated.

[6] Years reported are fiscal years: 2013 (July 2012-June 2013), 2014 (July 2013-June 2014) and 2015 (July 2014-June 2015).

what can be extracted from (possibly larger) innovation data sets that include all subsectors of manufacturing but with few observations per industry. We believe that by focusing on two relatively similar sub-sectors (textile and apparel), we get greater homogeneity in the types of innovations under study.

3.2 Model

In line with section 2, we are interested in understanding the drivers of firm growth, in particular the effect of innovation, alone, and in interaction with size and age characteristics of the firm. In line with previous empirical research (Evans, 1987, Goedhuys and Sleuwaegen, 2010), we first specify the following equation to estimate growth:

$$Growth_{i,t+2} = \alpha_0 + \alpha_1 ln(Size_{it}) + \alpha_2 [ln(Size_{it})]^2 + \alpha_3 ln(Age_{it}) + \alpha_4 [ln(Age_{it})]^2 + \alpha_5 (Innovation_i) + \alpha_6 (lnSize_{it}) * (lnAge_{it}) + \alpha_7 (Controls_i) + \epsilon_{it} \quad (1)$$

The dependent variable corresponds to growth between 2013 and 2015. *Growth* and *Size* are measured in terms of employment in the first setting, and in terms of sales in the second. *Innovation* is represented by three different indicators; technological innovation, continuous R&D, and innovation investment intensity (see table 1 for definitions), and *Controls* include exports, human capital, sectoral dummy for the apparel manufacturers, location dummy for the Sindh province, and expenditure on information communication and technology (ICT).

To delve deeper into the question of whether innovation is more important for growth when the firms are young or small, we interact firm size and firm age with innovation, as expressed in equation 2:

$$Growth_{i,t+2} = \beta_0 + \beta_1 ln(Size_{it}) + \beta_2 [ln(Size_{it})]^2 + \beta_3 ln(Age_{it}) + \beta_4 [ln(Age_{it})]^2 + \beta_5 (Innovation_i) + \beta_6 (lnSize_{it}) * (lnAge_{it}) + \beta_7 (lnSize_{it}) * (Innovation_i) + \beta_8 (lnAge_{it}) * (Innovation_i) + \beta_9 (Controls_i) + \epsilon_{it} \quad (2)$$

Finally, we follow Czarnitsky and Delanote (2012) and define YICs more formally using a number of criteria (see section 3.3.2) and test whether YICs have a higher growth performance in the following way:

$$Growth_{i,t+2} = \gamma_0 + \gamma_1 ln(Size_{it}) + \gamma_2[ln(Size_{it})]^2 + \gamma_3 ln(Age_{it}) + \gamma_4[ln(Age_{it})]^2 + \gamma_5(Innovation_i) + \gamma_6(lnSize_{it}) * (lnAge_{it}) + \gamma_7(YIC_{it}) + \gamma_8(Controls_i) + \epsilon_{it} \quad (3)$$

Estimation

We first estimated the previous equations (1)-(3) using OLS. Typical for OLS is that it shows how the mean of the (conditional) growth distribution changes systematically with co-variates. Second, we apply quantile regression techniques as an alternative way to explore these relationships more fundamentally (Koenker & Hallock, 2001). Quantile regression explains how covariates not only affect the location of the conditional growth distribution, but also its scale and shape. Looking at the impact on higher quantiles of the growth distribution, we can learn which variables stretch the upper tails of the conditional growth distribution, revealing the factors that generate a significant number of high growth firms (Coad and Rao, 2008, Goedhuys & Sleuwaegen, 2010). Rather than using predefined criteria to define YICs, in the quantile regression we explain firm growth by our variables of interest, entered into the equation as continuous variables, as in equation (2), and focus on the higher quantiles. In this way we can also relax the (arbitrary) choices that we made to define our young innovative companies.

3.3. Variables

3.3.1. Firm growth

Firm growth, i.e. changes in the firm' size, can be measured using a number of size indicators, such as growth in employees, sales or assets. Among these the most commonly used indicators are employment growth and sales growth (Moreno & Coad, 2015). Given our focus on Pakistan and the labour intensive industries textiles and garments, we mainly measure growth in terms of employment creation, over the period 2013-15, but also test the robustness of our results using sales growth.

The existing literature, mainly from developed countries (Bottazzi et al., 2011; Bottazzi & Secchi, 2006) and some of the emerging literature from developing countries (Yu et. al., 2015 for China and Mathew, 2017 for India), has shown that the distribution of firm growth rate is heavy-tailed. Figure 1 shows the distribution of employment and sales growth in our sample during 2013-15. Both employment and sales growth distributions are extremely heavy tailed suggesting that only a small group of firms experienced very high growth in our sample.

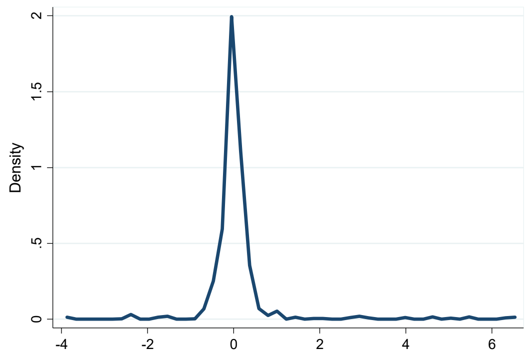

Figure 1(a): Employment growth 2013-15

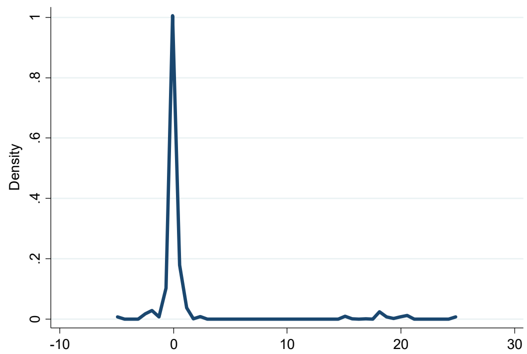

Figure 1(b): Sales growth 2013-15

3.3.2. Innovation and Young innovative companies (YICs)

Our survey data enable us to measure innovation in three distinct ways: i) innovation output, ii) innovation effort, and iii) innovation intensity. Innovation output is represented by technological innovation measured as a dummy variable (Tech. Inn) which equals one if a firm introduced product and/or process innovation that was at least new to the firm. Innovation effort is represented by a dummy variable (cont. R&D) which equals one if a firm reported performing R&D on continuous basis. And innovation investment is represented by a continuous variable (Inn. Investment), which represents total investment in innovation related activities. For the definition of YICs, we created an innovation investment variable (Inn. Intensity.), which equals one if the firm invested at least 5 percent of its turnover in innovation in 2015. We use these three dummies as innovation indicators and also to define a firm as a young innovative company. In all definitions of YICs, a firm is considered young if it was less than 10 years old in 2013. This age limit is relatively higher to the cut-off age used in the literature which has mostly used the European cut-off age. However, it is very reasonable given the mean age of 21 years in our sample.

Finally, for size, in YIC^E, we define firm size in terms of employment and take small firms with less than 50 employees in 2013. We also test the sensitivity of the results to this size cut-off by also taking a cut-off of less than 250 employees, hence allowing small and medium sized firms to be possible YICs.

The definition of young and innovative companies is given in equation (4), which provides three different indicators of young innovative companies using three alternative innovation indicators.

$$YIC_{it}^{E} = \begin{cases} 1 & \text{if } age_{it} < 10 \;\; employment_{it} < 50 \;\; \& \text{ Tech. Inn} = 1 \\ & \text{or Cont. RD} = 1 \\ & \text{or Inn. intensity} = 1 \\ 0 & \text{otherwise} \end{cases} \quad (4)$$

We also measure firm growth in terms of sales growth as a robustness test. In those equations we define YIC^S using the following criteria: firm size is expressed in sales, with a cut-off of Rs. 150 million in 2013 to define a small firm; age being <10 ; and innovation in the same way as described above.

3.3.3. Definition and summary statistics of variables

Table 1 gives an overview of the definition of the all variables used in the regressions and presents some summary statistics and Table-A2 in Appendix-A provides a correlation matrix of the explanatory variables.

Table 1: Description and summary statistics of the variables

Variable	Definition	Mean (STD)
Employment growth	Natural logarithm of employment in 2015 minus natural logarithm of employment in 2013.	0.10 (0.86)
Sales growth	Natural logarithm of turnover in 2015 minus natural logarithm of turnover in 2013.	0.95 (4.16)
Empl	Firm size measured as the natural logarithm of employment in 2013.	4.14 (1.76)
Sales	Firm size measured as the natural logarithm of turnover in 2013.	16.8 (4.67)
Age	Firm age measured as the natural logarithm of years in 2015.	21.7 (13.9)
Tech. Inn	=1 if a firm introduced product and/or process innovation during 2013-15 that were at least new to the firm.	0.496
Cont. R&D	=1 if a firm performed R&D on continuous basis during 2013-15.	0.241
Inn. Intensity	=1 if the firm invested at least 5 percent of its turnover in innovation in 2015.	0.215
Inn. Investment	Natural logarithm of total expenditure on innovation in 2015. Total expenditure is a sum of expenditure on (i) in-house R&D, (ii) external R&D, (iii) acquisition of machinery, equipment and software, (iv) acquisition of external knowledge, and (v) training for innovative activities.	7.87 (10.0)
YIC^E	=1 if < 50 workers and < 10 years old in 2013, and Tech. Inn = 1.	0.040
	=1 if < 50 workers and < 10 years old in 2013, and Cont. R&D = 1.	0.020
	=1 if < 50 workers and < 10 years old in 2013, and Inn. Intensity = 1.	0.019
	=1 if < 250 workers and < 10 years old in 2013, and Tech. Inn = 1.	0.069
	=1 if < 250 workers and < 10 years old in 2013, and Cont. R&D = 1.	0.029
	=1 if < 250 workers and < 10 years old in 2013, and Inn. Intensity = 1.	0.037
YIC^S	=1 if ≤ Rs. 150 million turnover and < 10 years old in 2013, and Tech. Inn = 1.	0.069
	=1 if ≤ Rs. 150 million turnover and < 10 years old in 2013, and Cont. R&D = 1.	0.029
	=1 if ≤ Rs. 150 million turnover and < 10 years old in 2013, and Inn. Intensity = 1.	0.037
Exports	Exports as the share of turnover, in 2013, ranging between 0 and 1.	0.318 (0.44)
Sindh	=1 if a firm is located in the province of Sindh.	0.318

Apparel	=1 if a firm is manufacturer of apparels.	0.188
Human capital	Natural logarithm of the total number of workers in 2015 with a university degree or/and professional diploma.	1.76 (2.23)
ICT	Natural logarithm of total expenditure in 2013 on information communication and technology.	8.88 (8.87)

Table 2 summarises the statistics of numbers of observations, firm size and age, investment in innovation and innovation outcomes, by industry.

Table 2: Sample characteristics

	Obs	***Employment***		***Age***	***Cont. R&D****	***Inn investment intensity*****	***Product****	***Process****
		Mean	*Median*	*Mean*		*Mean*		
Textiles	306	311	40	22	19	8.38	28	38
Apparel	71	509	80	20	45	11.68	56	52
Total	377	348	50	21	24	9.3	33	41

Note: * measured as a percentage, ** measured as a percentage of turnover in 2015 for firms reporting positive expenditures.

Overall the textiles and apparel sectors are very labour intensive, with a mean size of 348 employees. The mean age of firms is 21 years suggesting that on average firms are relatively old. Table 2 also shows that the firms that spent on innovation spent an average of 9 percent of turnover in 2015. Also, about one-fourth of the firms reported that they performed R&D continuously during the period 2013-15. At the same time, one third of firms introduced at least one product innovation, and forty-one percent firms introduced at least one process innovation during the 2013-15 period. There are some noticeable differences between the textile and apparel sectors: firms in the apparel sector were larger, younger, spent more on innovation and introduced more innovations during the period.

4. Results

4.1. Young Innovative Companies and employment growth

Table 3 presents the results of the employment growth estimations, where we explore the separate effects of size, age and innovation (equation 1), and estimate a specification that includes interaction terms for size and innovation and age and innovation (equation 2). Column 1 shows the results with a dummy for technological innovation, column 2 with a dummy for continuous R&D, and column 3 with innovation investment as a proxy for innovation. Size and age enter the equation as continuous variables.

Table 3: Results of employment growth estimations, with different innovation indicators

Innovation:	[a]**Tech. Inn**		[a]**Cont. R&D**		[a]**Inn. investment**	
		Interaction		*Interaction*		*Interaction*
Empl	-0.843***	-0.901***	-0.822***	-0.898***	-0.833***	-0.895***
	(0.133)	(0.124)	(0.133)	(0.120)	(0.133)	(0.118)
Empl squared	0.036***	0.034**	0.032***	0.047***	0.033***	0.034*
	(0.012)	(0.014)	(0.012)	(0.016)	(0.012)	(0.013)
Age	-1.005***	-0.800***	-1.037***	-0.895***	-0.989***	-0.753***
	(0.262)	(0.280)	(0.264)	(0.269)	(0.261)	(0.272)
Age squared	0.090*	0.062	0.092**	0.078*	0.082*	0.046
	(0.046)	(0.045)	(0.046)	(0.043)	(0.045)	(0.043)
Empl*Age	0.071**	0.112***	0.075**	0.082**	0.076**	0.114***
	(0.034)	(0.035)	(0.035)	(0.037)	(0.034)	(0.036)
Innovation (a)	0.196***	1.684***	0.188**	1.905***	0.011***	0.091***
	(0.066)	(0.430)	(0.081)	(0.410)	(0.004)	(0.020)
Innovation*Empl	--	-0.048	--	-0.136**	--	-0.003
		(0.057)		(0.056)		(0.002)
Innovation*Age	--	-0.452***	--	-0.372***	--	-0.023***
		(0.101)		(0.122)		(0.005)
Controls						
Exports	-0.217**	-0.195**	-0.200**	-0.191**	-0.227**	-0.224***

	(0.088)	(0.084)	(0.088)	(0.081)	(0.092)	(0.086)
Human capital	0.200***	0.199***	0.198***	0.188***	0.193***	0.185***
	(0.040)	(0.039)	(0.041)	(0.038)	(0.040)	(0.040)
Sindh	-0.089	-0.102*	-0.077	-0.071	-0.079	-0.079
	(0.059)	(0.058)	(0.060)	(0.057)	(0.059)	(0.056)
Apparel	0.131	0.100	0.121	0.080	0.127	0.110
	(0.084)	(0.077)	(0.083)	(0.074)	(0.082)	(0.071)
ICT	0.004	0.002	0.004	0.003	0.003	0.001
	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)
Marginal effects (dy/dx at means)						
Empl	-0.315***	-0.315***	-0.336***	-0.305***	-0.334***	-0.302***
	(0 .051)	(0 .051)	(0 .052)	(0 .048)	(0 .052)	(0 .051)
Age	-0.201***	-0.201***	-0.190***	-0.190***	-0.194***	-0.194***
	(0.052)	(0.052)	(0.054)	(0.052)	(0.055)	(0.052)
Observations	377	377	377	377	377	377
R-squared	0.635	0.672	0.632	0.669	0.636	0.679

Note: The parentheses contain robust standard errors. ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively.

In line with the existing literature, the results in Table 3 confirm that smaller firms grow faster than larger ones. We also find evidence in support of non-linearity in the relationship between firm size and employment growth. The squared size variable is positive and statistically significant in all specifications. The relationship between firm age and employment growth is equally negative, implying that younger firms grow faster. For age as well, a positive and significant coefficient for the squared age variable indicates a non-linear relationship between firm age and employment growth. However, it is insignificant in two specifications (column 2 and 6). The positive interaction term between firm size and age shows that growth rates drop as firms grow larger and older, in other words growth flattens out as firms move up the size distribution. Overall, the marginal effects at sample means are very similar for all specifications and confirm that both size and age have negative and significant impacts on employment growth. Our second hypothesis is regarding the impact of innovation on employment growth. We found innovative firms grow faster: there is a positive and significant impact of innovation on employment growth for all the three proxies of innovating firms. Firms introducing technological innovation experienced about 20 percent points higher employment growth than the non-innovators. Similarly, firms performing continuous R&D experience about 19 percent points higher employment growth than the firms not performing R&D on a continuous basis including those who occasionally invest in R&D. These results imply that a 10 percent increase in innovation investment is associated with an increase in employment growth by about 1 percent points. Overall, the results in Table 3 report a substantial job creation role of innovation in the Pakistani textile and apparel manufacturing sector.

One of the interesting questions is regarding the interaction of innovation with firm size and age. This captures the joint impact of innovation and size, and innovation and age over and above their main effect. We found younger innovative companies grow faster: there is a negative and significant coefficient for the firm age and innovation interaction for all the three proxies of innovation. This finding is in line with the empirical evidence discussed earlier and shows a moderating role of age in the relationship between firm growth and innovation, be it technological innovation, continuous R&D, or innovation investment. Firm size also seems to play similar moderating role. A negative sign of the coefficient for all the three proxies of innovation implies that smaller innovative firms grow faster. However, this relationship is statistically significant only in the case of continuous R&D, which sheds some light on the type of innovation activities that contribute to the employment growth of smaller firms. Continuous R&D represents more of the internal absorptive capacity and innovation persistence of firms and this finding shows that smaller firms with these characteristics experience higher employment growth.

From the other controls, Table 3 shows that the export intensive firms grow more slowly and the results are consistent across all specifications. Similar findings are reported by Mathew (2017) in the case of India. This could be because exporting firms on average are larger and older[7], meaning that as they expand, their growth in employment is smaller; or more capital intensive, meaning that as they expand they require less labour. Among the other controls, employment growth increases with human capital. Highly educated and qualified labor suggests the presence of capabilities and absorptive capacity needed for growth. Finally, there is a negative coefficient

[7] In our sample, mean size of exporting firms is 790 and mean age is 22.83, that are significantly higher in comparison to the mean size and age for overall sample reported in table 2.

for Sindh suggesting that firms located in the province of Sindh grow more slowly but it is only significant in one specification.

Table 4 presents the regression results for the models where we have introduced a dummy variable for 'Young Innovative Companies' (equation 3), using different definitions of innovation and different threshold levels for defining the young, small and innovative firm (<50 employees and <250 employees). Column 1 and 2 show the results with technological innovation, columns 3 and 4 with continuous R&D, and columns 5 and 6 with innovation investment as a proxy for innovation.

Table 4: Results of employment growth estimations, with different definitions of YICs

YICs:	[a]**Tech. Inn**		[a]**Cont. R&D**		[a]**Inn. investment**	
	Empl<50	*Empl<250*	*Empl<50*	*Empl<250*	*Empl<50*	*Empl<250*
Empl	-0.799***	-0.842***	-0.752***	-0.803***	-0.684***	-0.817***
	(0.134)	(0.132)	(0.128)	(0.127)	(0.144)	(0.128)
Empl squared	0.034***	0.036***	0.032**	0.033***	0.030**	0.034***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Age	-0.947***	-0.946***	-1.036***	-0.990***	-0.908***	-0.892***
	(0.275)	(0.276)	(0.258)	(0.263)	(0.282)	(0.272)
Age squared	0.089*	0.083*	0.106**	0.092**	0.093**	0.072
	(0.046)	(0.047)	(0.042)	(0.044)	(0.044)	(0.046)
Empl*Age	0.063*	0.072**	0.060*	0.070**	0.048	0.075**
	(0.035)	(0.034)	(0.034)	(0.034)	(0.036)	(0.034)
Innovation (a)	0.146**	0.160***	0.086	0.096	0.006**	0.008**
	(0.058)	(0.060)	(0.072)	(0.075)	(0.003)	(0.003)
YIC^E	0.371	0.197	0.891**	0.568**	1.239**	0.519**
	(0.267)	(0.151)	(0.419)	(0.276)	(0.558)	(0.238)
Controls						
Exports	-0.194**	-0.215**	-0.162*	-0.191**	-0.177**	-0.226**

	(0.084)	(0.087)	(0.083)	(0.085)	(0.084)	(0.090)
Human capital	0.203***	0.202***	0.200***	0.202***	0.180***	0.189***
	(0.040)	(0.041)	(0.040)	(0.040)	(0.040)	(0.040)
Sindh	-0.097*	-0.100*	-0.093	-0.087	-0.083	-0.096*
	(0.058)	(0.057)	(0.058)	(0.059)	(0.057)	(0.057)
Apparel	0.118	0.125	0.105	0.100	0.124	0.128
	(0.081)	(0.082)	(0.077)	(0.078)	(0.076)	(0.080)
ICT	0.003	0.003	0.003	0.003	0.003	0.003
	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)
Observations	377	377	377	377	377	377
R-squared	0.640	0.638	0.647	0.641	0.660	0.645

Note: The parentheses contain robust standard errors. ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively.

We find a positive effect of technological innovation on employment growth, raising it by 14-16 percent points, but no additional effect for young and small firms. The coefficient of continuous R&D becomes insignificant when the YICs is included, implying that only small, young continuous and R&D performing firms experience significantly higher growth. For innovation investment, we see that the effect is positive, with an additional positive effect for YICs.

That YICs experience higher employment growth only in the case when they themselves continuously invest in knowledge creation, or when they spend substantial resources suggests that the types of innovation activities and the intensity of the investment plays a key role in the growth of young innovative firms. Both, investing a high percentage of turnover and performing R&D on a continuous basis could be riskier decisions for small and young companies, however, they could generate more radical innovation which contributes to firm growth. There are also noticeable differences in terms of size cut-off of YICs: the small sized YICs (<50 employees) experience higher employment growth than the small to medium sized YICs (<250 employees).

4.2 Innovation profile of YICs

The literature discussed earlier indeed suggests that fundamental differences in innovation between the YICs and incumbent firms are at the origin of this different growth performance. The YICs are believed to be more risk takers and introduce more radical innovation than the established incumbents. Table 5 below sheds some additional light on these possible underlying mechanisms and reports the differences between YICs and non-YIC innovative firms in terms of intensity and distribution of innovation investment and product innovation profile. In order to compare YICs with non-YICs, we restrict ourselves to a sample of firms who engage in innovation activities by investing resources.

Table 5: Innovation profile of YICs vs other innovative firms (non-YIC)

	$YIC^E = 1(a)$	$YIC^E = 0$	$YIC^E = 1(b)$	$YIC^E = 0$	$YIC^E = 1(c)$	$YIC^E = 0$
*Cont. R&D**	70.00	54.74	100	53.57	71.43	55.00
Innovation investment intensity*						
Total	27.66	7.96	34.23	8.05	39.00	7.82
R&D	3.89	1.50	5.27	1.49	5.50	1.48
Machinery	23.54	5.51	28.77	5.64	33.21	5.42
Product innovation*						
Overall	60	68	71	67	71	67
New to the market	20	20	29	20	29	20

Note: All indicators are for a sub set of firms reporting any investment in innovation.

* proportions of firms

**Innovation investment intensity: all values reported as a share of turnover in 2015; Total = total investment in innovation; R&D = in-house R&D expenditures; Machinery = innovation related expenditures on the purchase of machinery, Hardware, Software, and lease/rental of machinery and equipment;

New to market = Product innovation introduced by firm during 2013-15 that was new to the firm's market.

(a) defined as age < 10 & employment < 50 & Technological innovator, (b) defined as age < 10 & employment < 50 & continuous R&D performer, (c) defined as age < 10 & employment < 50 & with innovation investment intensity ≥ 5% of turnover.

The first row shows the difference between YICs and other (non-YIC) innovative companies in terms of performing R&D on continuous basis. Irrespective of the definition of YICs, a substantially larger share of YICs perform R&D on a continuous basis as compared to more established innovative companies. Statistics on innovation expenditures also reveal striking differences between YICs and non-YIC innovative companies. YICs on average have three to four times more investment in innovation than the established innovative companies. These data reveal the risk taking behaviour of YICs as they are investing up to 39 percent of their turnover in innovation in comparison to about 8 percent spent by established innovative companies. A further decomposition of innovation expenditures shows that YICs also spend more on R&D, a risky undertaking. In terms of percentage of their turnover, YICs on average spend about three times more on R&D than the non-YIC innovative companies.

In terms of product innovation, there is no noticeable difference between YICs and non-YIC innovative companies. However, YICs introduce more radical innovations: twenty-nine percent of YICs introduced products that were new to their market in comparison to 20 percent of non-YIC innovative companies.

Overall, the summary statistics in table 7 show that YICs in our sample spend larger share of their turnover on innovation, they spend more on in-house R&D, and they introduce more radical innovations than the incumbent innovative companies.

4.3. Results from quantile regressions

The previous sections call for an analysis that delves deeper into the effect of large innovation investment intensities for firms of different age and size. We do this with a quantile regression, relaxing the size, age and innovation cut-off points we use to define YICs, entering the size, age and innovation investment variables as continuous variables in the equation and investigating their effect on the higher quantiles of the conditional growth distribution where superior growth performances can be found. The results of the quantile regression estimation using employment growth as the dependent variable are presented in table 6. We pay particular attention to the interaction terms between innovation and size and innovation and age. The results show that irrespective of the innovation measure, the coefficients of innovation go up in magnitude and significance as we move from the lower to the higher quantiles. For instance technological innovation has no significant impact on employment creation in the lower quantiles, but goes up gradually as we go to higher quantiles, underscoring the importance of innovation for high growth of firms. This also holds for the other innovation measures. Looking at the interaction between innovation and age, throughout the quantiles we see a lower innovation effect for older firms, indicating that the effect of innovation is mainly a strong driver of high growth for young innovative firms. A similar effect is found for small firms and innovation, although the effect is slightly smaller in size and significance,. In sum, the results largely confirm what we have also found in the previous sections where we made use of specific criteria to define young innovative companies.

Table 6: Quantile regression estimates for employment growth (100 bootstrap replications)

Innovation:	[a]Tech. Inn					[a]Cont. R&D					[a]Inn. Investment				
Quantile:	10%	25%	50%	75%	90%	10%	25%	50%	75%	90%	10%	25%	50%	75%	90%
Empl	-0.320	-0.356**	-0.581***	-0.877***	-1.117***	-0.0452	-0.311**	-0.491**	-0.843***	-1.331***	-0.214	-0.498***	-0.571***	-0.893***	-1.074***
	(0.214)	(0.163)	(0.209)	(0.182)	(0.256)	(0.216)	(0.156)	(0.198)	(0.181)	(0.258)	(0.262)	(0.168)	(0.166)	(0.172)	(0.279)
Empl squared	-0.012	0.007	0.017**	0.035**	0.070**	-0.005	0.005	0.016	0.049**	0.092***	-0.013	0.006	0.0140*	0.034*	0.070**
	(0.019)	(0.010)	(0.008)	(0.015)	(0.029)	(0.015)	(0.012)	(0.012)	(0.019)	(0.025)	(0.018)	(0.011)	(0.008)	(0.019)	(0.028)
Age	0.076	-0.291	-0.944**	-1.382***	-0.919	0.229	-0.290	-0.590	-1.215***	-1.159	0.165	-0.435*	-0.751**	-1.386***	-0.832
	(0.42)	(0.214)	(0.378)	(0.362)	(0.829)	(0.500)	(0.209)	(0.458)	(0.442)	(0.801)	(0.419)	(0.224)	(0.346)	(0.340)	(0.690)
Age squared	-0.045	0.015	0.088*	0.135**	0.086	-0.051	0.014	0.041	0.130**	0.114	-0.053	0.0152	0.052	0.133**	0.0787
	(0.070)	(0.033)	(0.045)	(0.060)	(0.115)	(0.084)	(0.033)	(0.058)	(0.065)	(0.110)	(0.072)	(0.033)	(0.047)	(0.059)	(0.101)
Empl*Age	0.068	0.061*	0.121**	0.163***	0.099	-0.030	0.055*	0.082*	0.093**	0.091	0.035	0.107***	0.125***	0.172***	0.088
	(0.053)	(0.034)	(0.046)	(0.043)	(0.081)	(0.058)	(0.032)	(0.042)	(0.042)	(0.075)	(0.063)	(0.0364)	(0.040)	(0.042)	(0.067)
Innovation (a)	**1.162**	**0.791**	**1.346*** **	**1.819*** **	**1.835** **	**-0.038**	**0.782**	**1.252***	**2.320*** **	**2.007** **	**0.038**	**0.066*** **	**0.079*** **	**0.114*** **	**0.108** **
	(0.740)	(0.492)	(0.494)	(0.635)	(0.885)	(1.136)	(0.517)	(0.685)	(0.779)	(1.001)	(0.047)	(0.025)	(0.0236	(0.031)	(0.044)
Empl*Innov.	**0.078**	**-0.006**	**-0.066***	**-0.093***	**-0.129**	**0.029**	**-0.003**	**-0.063**	**-0.204** **	**-0.170**	**0.004**	**-0.001**	**-0.003**	**-0.005***	**-0.007**
	(0.113)	(0.051)	(0.035)	(0.055)	(0.118)	(0.090)	(0.047)	(0.055)	(0.089)	(0.113)	(0.004)	(0.002)	(0.001)	(0.003)	(0.004)
Age*Innov.	**-0.479*** **	**-0.230***	**-0.333** **	**-0.448*** **	**-0.359***	**0.010**	**-0.228**	**-0.286**	**-0.378***	**-0.340**	**-0.015**	**-0.019*** **	**-0.020*** **	**-0.027*** **	**-0.022***
	(0.175)	(0.134)	(0.130)	(0.167)	(0.217)	(0.288)	(0.148)	(0.175)	(0.197)	(0.273)	(0.011)	(0.006)	(0.005)	(0.008)	(0.011)
Exports	-0.197	-0.114*	-0.055	-0.046	-0.096	-0.223*	-0.082	-0.038	-0.064	-0.058	-0.218	-0.114**	-0.102*	-0.077	-0.087
	(0.123)	(0.063)	(0.052)	(0.071)	(0.102)	(0.130)	(0.061)	(0.066)	(0.073)	(0.114)	(0.165)	(0.057)	(0.055)	(0.070)	(0.102)
Human capital	0.146**	0.089**	0.076***	0.0751**	0.123***	0.147**	0.079***	0.078***	0.107***	0.126***	0.130*	0.089***	0.071***	0.072***	0.113***
	(0.066)	(0.035)	(0.028)	(0.030)	(0.036)	(0.057)	(0.027)	(0.029)	(0.031)	(0.035)	(0.068)	(0.030)	(0.020)	(0.027)	(0.034)
Sindh	-0.116	-0.115**	-0.097**	-0.063	-0.085	-0.058	-0.092**	-0.087**	-0.079	-0.059	-0.086	-0.133***	-0.071	-0.067	-0.093
	(0.100)	(0.045)	(0.042)	(0.051)	(0.093)	(0.096)	(0.046)	(0.041)	(0.055)	(0.091)	(0.078)	(0.044)	(0.043)	(0.064)	(0.094)
Apparel	-0.003	0.0360	0.082	0.107*	0.125*	-0.020	0.0129	0.060	0.073	0.105	-0.008	0.047	0.051	0.097	0.080
	(0.112)	(0.089)	(0.072)	(0.058)	(0.071)	(0.109)	(0.072)	(0.059)	(0.070)	(0.085)	(0.142)	(0.078)	(0.063)	(0.073)	(0.078)

ICT	0.005	-0.001	-0.002	-0.002	0.002	0.003	-0.001	0.001	-0.000	0.002	0.005	-0.000	-0.001	-0.002	0.003
	(0.006)	(0.003)	(0.002)	(0.003)	(0.004)	(0.005)	(0.002)	(0.002)	(0.003)	(0.004)	(0.005)	(0.002)	(0.002)	(0.003)	(0.004)
Observations	377	377	377	377	377	377	377	377	377	377	377	377	377	377	377
Pseudo R-squared	0.128	0.109	0.105	0.311	0.533	0.108	0.096	0.090	0.302	0.541	0.121	0.126	0.132	0.319	0.546

Note: The parentheses contain bootstrap standard errors. ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively.

5. Extended analysis and discussion

5.1. Absolute employment effects of YICs versus other firms

The growing interest that YICs and high-growth firms have received in the recent literature and policy debates has much to do with job creation. The findings from our regression estimations indeed show that YICs have a positive impact on employment growth *rates*. However, one intriguing question that remains is 'Are YICs also the major contributors to *absolute* job creation?' Also important is the question whether it is the combination of smallness, young age and innovation that creates more jobs as compared to either smallness, being younger, or innovation alone. To address this issue further, table 7 presents some summary statistics of employment growth and net job creation (Employment in 2015 - Employment in 2013) by various sub-groups of firms in the sample.

Table 7: Summary statistics of employment creation

Types	**Mean growth in employment in %**	**Mean net employment creation**
Total sample	9.5	24.77
Young (<10 years old)	53	25.15
Small (<50 employees)	26	11.96
Medium (≥ 50 but <250 employees)	-3.5	00.18
Large (≥ 250 employees)	-12	84.36
Small and Young	79	35.83
Technological innovators	13	53.47
Continuous R&D performing	23	118.87
Non-innovators	05	-05.15
YIC^E (a)	183	80.73
YIC^E (b)	248	136.57
YIC^E (c)	366	164.00

Note: (a) defined as age < 10 & employment < 50 & Technological innovator, (b) defined as age < 10 & employment < 50 & continuous R&D performer, (c) defined as age < 10 & employment < 50 & with innovation investment intensity ≥ 5% of turnover.

The findings show that on average small and young firms grow faster and create more absolute jobs than the average firm in the sample. Similarly, on average innovative firms grow faster than the average firm in the sample. Innovative firms also grow faster and create more jobs than small and young firms as well as than the non-innovative firms. The importance of innovation can be seen from the finding that on average non-innovative firms in the sample fired a net of 5 workers between 2013 and 2015. There are also noticeable differences between the types of innovators. On average firms that perform R&D on continuous basis create more than twice as many jobs as created by the technological innovators. This indicates that the self-reported product and process innovation from innovation surveys help to distinguish between more innovation active firms and non-innovators, but that performing R&D in-house, on a continuous basis and with higher intensities are even better indicators related to firm growth.

Table 7 also reveals that the YICs (a combination of being small, young and innovative) create substantially more absolute employment. For example, an average YIC (small, young and investing at least 5 percent of turnover in innovation investment) created 164 new jobs in 2013-15, it grew more than 36 times faster than the average firm in the sample, and created 6.6 times more absolute jobs than the average firm in the sample. However, in the case of technological innovation, an average YIC created fewer jobs than the average large sized firms or average firm doing R&D on continuous basis. The highest number of jobs on average is generated by firms that are small, young and their innovation investment intensity is 5 percent or more of their turnover.

5.2. Sales growth

So far the analysis has focused on firm growth measured by employment. To test the robustness of our findings to an alternative firm growth measure, Table 8 presents estimation results with sales growth as the dependent variable. We show the results of equations (1) and (3) using OLS estimation[8].

---

[8] Sales growth quantile regression results are available on request.

Table 8: Results of sales growth estimations, with different innovation indicators

Innovation:	[a]**Tech. Inn**		[a]**Cont. R&D**		[a]**Inn. investment**	
Sales	-1.732***	-1.732***	-1.746***	-1.750***	-1.745***	-1.745***
	(0.079)	(0.078)	(0.077)	(0.076)	(0.078)	(0.078)
Sales squared	0.050***	0.050***	0.050***	0.050***	0.050***	0.050***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)
Age	-0.559	-0.561	-0.510	-0.467	-0.478	-0.449
	(0.661)	(0.653)	(0.658)	(0.658)	(0.662)	(0.657)
Age squared	0.260	0.260	0.244	0.245	0.237	0.237
	(0.165)	(0.164)	(0.163)	(0.164)	(0.163)	(0.164)
Sales*Age	-0.055*	-0.055*	-0.052*	-0.053*	-0.052*	-0.053*
	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
Innovation (a)	0.370***	0.371***	0.276**	0.179	0.0154***	0.014***
	(0.100)	(0.092)	(0.118)	(0.128)	(0.005)	(0.005)
YIC^S	--	-0.008	--	0.584*	--	0.184
		(0.227)		(0.324)		(0.329)
Controls						
Exports	0.079	0.078	0.130	0.145	0.096	0.097
	(0.139)	(0.139)	(0.144)	(0.144)	(0.146)	(0.147)
Human capital	0.093**	0.093**	0.091**	0.093**	0.087**	0.086**
	(0.041)	(0.041)	(0.042)	(0.041)	(0.041)	(0.041)
Sindh	-0.449***	-0.449***	-0.433***	-0.445***	-0.436***	-0.443***
	(0.149)	(0.153)	(0.151)	(0.153)	(0.149)	(0.153)
Apparel	-0.026	-0.026	-0.045	-0.061	-0.035	-0.033
	(0.127)	(0.126)	(0.128)	(0.125)	(0.126)	(0.126)
ICT	-0.000	-0.000	0.001	-0.000	-0.001	-0.001
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Observations	377	377	377	377	377	377
R-squared	0.948	0.948	0.947	0.948	0.948	0.948

Note: The parentheses contain robust standard errors. ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively.

Innovation significantly contributes to a firm's sales growth as well. Irrespective of the proxy used for innovation, there is a positive and significant coefficient of innovation implying that innovative firms experience higher sales growth. Technological innovators have 37 percent points higher sales growth, and the firms performing continuous R&D have about 28 percent points higher sales growth. A 10 percent points increase in innovation investment results in about 1.5 percent points increase in sales growth. The size of the innovation coefficients suggests that in comparison to employment growth, innovation has a larger impact on sales growth. As discussed in the literature section, innovation might lead to improved efficiency or modernisation of the production processes that requires less labor, reflecting some of the labor saving aspects of innovation as well. When introducing the YIC variable, we see that in the case of continuous R&D, it is only positive if taking place in young innovative companies. Both technological innovation and innovation investment are significant in the equation though, but we observe no additional effect for firms of small size and young age.

In sum, we find that innovation, whichever measure used, emerges as an important driver of firm growth, both in terms of sales and employment. Age and size seem to play moderating role between innovation and firm growth.

6. Conclusion

In this paper, we contribute to the emerging literature on the significance of innovation for the post-entry performance of firms in developing countries, where industries are more labor intensive and most of the innovations are incremental in nature and driven by the acquisition of new vintage machinery. Our results support the hypotheses that smaller and younger firms grow faster. Even though innovation in developing countries is generally described as incremental in nature and closely related to the development of technological capabilities to catch up with frontier technologies, we found indigenous innovation efforts to be an important driver of employment growth of firms in the textiles and apparel sectors of Pakistan, robust to different measures of innovation and econometric specifications. Quantile regression results show that innovation has increasingly large and increasingly significant impacts in the higher quantiles of the growth distribution.

Further, we test whether the *combined effect* of small size, young age, and innovation raises growth even further. The data indeed indicate that this is the case. Our results back up the presumption that YICs engage more heavily in risky innovation activities and produce more radical innovations than incumbent firms, pushing their growth performance above that of incumbent innovators. The data confirms that YICs are more intensively engaged in innovation activities and introduce more radical innovations. It is mainly continuous R&D (for employment and sales growth) and higher innovation investment intensity (for employment growth) which are innovation activities leading to high growth, especially among young innovative firms. These findings also suggest that while the self-reported technological innovation is useful to distinguish between more innovation active firms and non-innovators, performing R&D in-house on a continuous basis and with higher intensities are better indicators related to employment creation, especially for smaller and younger companies. Our findings also reveal that innovative firms not only display higher growth *rates*, but also create more jobs in *absolute* terms. Also here we find striking differences depending on how we define innovative firms: on average innovative firms that performed R&D on continuous basis created more than twice as many jobs than product or process innovators.

Some important policy implications arise from this analysis. Since small, young, innovative companies are particularly conducive to employment generation they can be considered as good candidates for targeted support tailored to sustain their entry and growth. Relaxing the binding constraints to innovative entrepreneurs and young innovative companies may be an effective way to boost employment.

Second, from an innovation measurement perspective, the findings show that questions on continuous R&D efforts and innovation investment expenditures are more accurate than questions on the introduction of new-to-the-firm products and processes (which are possibly too broadly interpreted in the particular context in which they are asked) to identify firms with superior employment creation potential.

Finally, we are aware of the limitations of the study, which are largely related to the cross-sectional nature of the data, limiting to establish strong causal relations and the relatively small number of firms. We nevertheless think that the sample is unique firstly in terms of homogeneity of firms and secondly in terms of the development of the data set itself which was the result of a significant collection effort involving various stakeholders. Finally it should also be noted that we focused on product and process innovation and on firm growth in terms of employment or sales. However, from the survey interviews, it was clear that managerial innovation and organisational change were also important drivers for sustained growth. We did not include this in the analysis, because product, process and organisational innovations are often correlated with each other and with organisational innovation and it is generally difficult to disentangle the effects of the various types of innovation.

References

Abramovitz, M. (1986). Catching up, forging ahead, and falling behind. *Journal of Economic History,* 46: 386-406.

Aghion, P. and P. Howitt (1992). A model of growth through creative destruction. *Econometrica,* 60 (2), 323-351.

Antonucci, T., & Pianta, M. (2002). Employment effects of product and process innovation in Europe. *International Review of Applied Economics*, *16*(3), 295-307.

Arouri, H., Ben Youssef, A., Quatraro, F., & Vivarelli, M. (2018). Drivers of growth in Tunisia: Young Firms vs incumbents. (No. 019). *United Nations University-Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT).*

Audretsch, D. B. (1995). Innovation, growth and survival. *International Journal of Industrial Organization, 13*(4), 441-457.

Audretsch, D. B., Segarra, A., & Teruel, M. (2014). Why don't all young firms invest in R&D? *Small Business Economics*, 43(4), 751-766.

Audretsch, D., Coad, A., & Segarra, A. (2014). Firm growth and innovation. *Small Business Economics, 43*(4), 743-749.

Baumol, W. J. (2002). *The free-market innovation machine: Analyzing the growth miracle of capitalism*. Princeton university press.

Bell, M., & Albu, M. (1999). Knowledge systems and technological dynamism in industrial clusters in developing countries. *World Development*, 27(9), 1715-1734.

Bell, M., & Pavitt, K. (1992). Accumulating technological capability in developing countries. *The World Bank Economic Review*, *6*(suppl_1), 257-281.

Bigsten, A., & Gebreeyesus, M. (2007). The small, the young, and the productive: Determinants of manufacturing firm growth in Ethiopia. *Economic Development and Cultural Change*, *55*(4), 813-840.

Bogliacino, F., & Pianta, M. (2010). Innovation and employment: a reinvestigation using revised Pavitt classes. *Research Policy*, 39(6), 799-809.

Bottazzi, G., & Secchi, A. (2006). Explaining the distribution of firm growth rates. *The RAND Journal of Economics*, *37*(2), 235-256.

Bottazzi, G., Coad, A., Jacoby, N., & Secchi, A. (2011). Corporate growth and industrial dynamics: Evidence from French manufacturing. *Applied Economics*, *43*(1), 103-116.

Caves, Richard E. (1998). Industrial Organization and New Findings on the Turnover and Mobility of Firms. *Journal of Economic Literature*, 36(4), December, 1947-1982.

Coad, A. (2009). *The growth of firms: A survey of theories and empirical evidence*. Edward Elgar Publishing.

Coad, A., & Rao, R. (2008). Innovation and firm growth in high-tech sectors: A quantile regression approach. *Research Policy, 37*(4), 633-648.

Coad, A., Segarra, A., & Teruel, M. (2016). Innovation and firm growth: Does firm age play a role? *Research Policy, 45*(2), 387-400.

Coe, D. T., & Helpman, E. (1995). International R&D spillovers. *European Economic Review*, *39*(5), 859-887.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35, 128-52.

Czarnitzki, D., & Delanote, J. (2013). Young Innovative Companies: the new high-growth firms? *Industrial and Corporate Change, 22*(5), 1315-1340.

Delmar, F., Davidsson, P., & Gartner, W. B. (2003). Arriving at the high-growth firm. *Journal of Business Venturing, 18*(2), 189-216.

Economic Survey of Pakistan 2015–2016. Ministry of Finance, Government of Pakistan.

Ericson, R., & Pakes, A. (1995). Markov-perfect industry dynamics: A framework for empirical work. *The Review of Economic Studies, 62*(1), 53-82.

Evans, D. S. (1987). Tests of alternative theories of firm growth. *Journal of Political Economy, 95*(4), 657-674.

Figueiredo, P. N. (2003). Learning, capability accumulation and firm differences: evidence from latecomer steel, *Industrial and Corporate Change*, 12(3), 607–643.

Fu, X., Pietrobelli, C., & Soete, L. (2011). The role of foreign technology and indigenous innovation in the emerging economies: technological change and catching-up. *World development*, *39*(7), 1204-1212.

Gibrat, R. (1931). *Les inégalités économiques* : Recueil Sirey.

Goedhuys, M., & Sleuwaegen, L. (2010). High-growth entrepreneurial firms in Africa: A quantile regression approach. *Small Business Economics, 34*(1), 31-51.

Goedhuys, M., & Sleuwaegen, L. (1999). Barriers to growth of firms in developing countries: evidence from Burundi. In: Audretsch D., Thurik, R. (eds.) *Innovation, industry evolution and employment*, Cambridge University Press, 297-314.

Goedhuys, M., Janz, N., & Mohnen, P. (2008). What drives productivity in Tanzanian manufacturing firms: Technology or business environment? *European Journal of Development Research, 20*(2), 199-218.

Goedhuys, M., Janz, N., & Mohnen, P. (2014). Knowledge-based productivity in low-tech industries: evidence from firms in developing countries. *Industrial and Corporate Change, 23*(1), 1-23.

Grossmann, G. M., & Helpman, E. (1991*). Innovation and growth in the global economy.* Cambridge MA: MIT Press.

Hall, P. H. (1994). *Innovation, economics and evolution: theoretical perspectives on changing technology in economic systems.* Harvester Wheatsheaf.

Jovanovic, B. (1982). Selection and the evolution of industry. *Econometrica, 50*(3), 649-670.

Kim, L. (1980). Stages of development of industrial technology in a developing country: a model. *Research Policy*, 9(3), 254-277.

Kim, L. (1997). *Imitation to Innovation: The Dynamics of Korea's Technological Learning, Harvard.* Harvard Business School Press.

Koenker, R., & Hallock, K. F. (2001). Quantile regression. *Journal of Economic Perspectives*, 15(4), 143-156.

Lall, S. (1992). Technological capabilities and industrialization. *World Development*, 20(2), 165-186.
Li, X. (2011). Sources of external technology, absorptive capacity, and innovation capability in Chinese state-owned high-tech enterprises. *World Development*, *39*(7), 1240-1248.

Little, A. D. (1977). *New technology-based firms in the United Kingdom and the Federal Republic of Germany: a report.* Anglo-German Foundation for the Study of Industrial Society.

Lucas, R. E., Jr. (1978). On the size distribution of business firms. *The Bell Journal of Economics, 9*(2), 508-523.

Majumdar, S.K., 1997. The impact of size and age on firm-level performance: some evidence from India. *Review of Industrial Organisation*, 12, 231–241.

Mathew, N. (2017). Drivers of firm growth: micro-evidence from Indian manufacturing. *Journal of Evolutionary Economics*, 27(3), pp.585-611.

Maula, M., Murray, G., & Jääskeläinen, M. (2007). *Public financing of young innovative companies in Finland*. Ministry of Trade and Industry, Finland.

McPherson, M. A. (1996). Growth of micro and small enterprises in southern Africa. *Journal of Development Economics*, *48*(2), 253-277.

Moreno, F., & Coad, A. (2015). High-growth firms: Stylized facts and conflicting results. In *Entrepreneurial growth: Individual, firm, and region* (pp. 187-230). Emerald Group Publishing Limited.

Nelson, R. R., & Winter. S., (1982). *An evolutionary theory of economic change*.

Nichter, S., & Goldmark, L. (2009). Small firm growth in developing countries. *World Development*, *37*(9), 1453-1464.

OECD, (2005). Oslo Manual. *Guidelines for Collecting and Interpreting Innovation Data,*

OECD, (2007). Eurostat-OECD Manual on Business Demography Statistics, Paris: OECD.

Pakes, A., & Ericson, R. (1998). Empirical implications of alternative models of firm dynamics. *Journal of Economic Theory, 79*(1), 1-45.

Pellegrino, G., Piva, M., & Vivarelli, M. (2011). How do young innovative companies innovate? *Handbook of research on innovation and entrepreneurship*, 403.

Quatraro, F., & Vivarelli, M. (2015). Drivers of Entrepreneurship and Post-entry Performance of Newborn Firms in Developing Countries. *The World Bank Research Observer, 30*(2), 277-305.

Research Policy, 9, 254-277.

Romijn, H. (1997). Acquisition of technological capability in development: A quantitative case study of Pakistan's capital goods sector. *World Development,* 25(3), 359-377.

Roper, S. (1997). Product innovation and small business growth: a comparison of the strategies of German, UK and Irish companies. *Small Business Economics*, *9*(6), 523-537.

Rostow, W. W. (1978). *The world economy; history and prospect* (No. 04; HC51, R6.).

Rosenberg, N. (1990), Why do Firms Do Basic Research With their Own Money? *Research Policy,* 19, 165–74.
Santarelli, E., & Tran, H. T. (2017). Young innovative companies: Are they high performers in transition economies? Evidence for Vietnam. *The Journal of Technology Transfer*, 42(5), 1052-1076.

Santi, C., & Santoleri, P. (2017). Exploring the link between innovation and growth in Chilean firms. *Small Business Economics*, 49(2), 445-467.

Schmookler, J. (1966). *Invention and Economic Growth*. Harvard University Press Cambridge.

Schneider, C., & Veugelers, R. (2010). On young highly innovative companies: why they matter and how (not) to policy support them. *Industrial and Corporate Change, 19*(4), 969-1007.

Schumpeter, J. A. (1934). *The Theory of Economic Development* (translation of second German edition by Redvers Opie). Cambridge, MA, Harvard University.

Schumpeter. (1942), *Capitalism, socialism and democracy*, New York, NY: Harper and Brothers.

Sleuwaegen, L., & Goedhuys, M. (2002). Growth of firms in developing countries, evidence from Côte d'Ivoire. *Journal of Development Economics, 68*(1), 117-135.

Teruel-Carrizosa, M. (2010). Gibrat's law and the learning process. *Small Business Economics, 34*(4), 355-373.

UNESCO – UIS (2017) Summary report of the 2015 IUS innovation data collection, available at: http://uis.unesco.org/sites/default/files/documents/ip37-summary-report-of-the-2015-uis-innovation-data-collection-2017-en.pdf (12.10.2018)

Vaona, A., & Pianta, M. (2008). Firm size and innovation in European manufacturing. *Small business economics*, *30*(3), 283-299.

Wadho, W., & Chaudhry, A. (2018). Innovation and firm performance in developing countries: The case of Pakistani textile and apparel manufacturers. *Research Policy*, 47(7), 1283-1294.

Yasuda, T. (2005). Firm Growth, Size, Age and Behavior in Japanese Manufacturing. *Small Business Economics, 24*(1), 1-15.

Yu, X., Dosi, G., Lei, J. and Nuvolari, A. (2015). Institutional change and productivity growth in China's manufacturing: the microeconomics of knowledge accumulation and "creative restructuring". *Industrial and Corporate Change*, 24(3), pp.565-602.

Zanello, G., Fu, X., Mohnen, P., & Ventresca, M. (2016). The creation and diffusion of innovation in developing countries: a systematic literature review. *Journal of Economic Surveys*, *30*(5), 884-912.

Appendix-A:

Table-A1: Comparison between a sample of 431 firms and the final working sample of 377

	$Empl_{2015}$	***Sectoral distribution****		***Age_{2015}***	***Cont. R&D****	***Inn investment intensity*****	***Product****	***Process****
	Mean	*Textiles*	*Apparel*	*Mean*		*Mean*		
Final (377)	348	81.25	18.75	21	24	9.3	33	41
431	351	81.68	18.33	21	23	9.1	31	37

Note: * measured as a percentage, ** measured as a percentage of turnover in 2015 for firms reporting positive expenditures.

Table-A2: Correlation matrix of explanatory variables

	Tech. Inn	***Cont. R&D***	***Inn. investment***	***Empl***	***Sales***	***Age***	***Exports***	***Human capital***	***Sindh***	***Apparel***
Tech. Inn	1.00									
Cont. R&D	0.55	1.00								
Inn. investment	0.76	0.62	1.00							
Empl	0.40	0.40	0.43	1.00						
Sales	0.18	0.20	0.19	0.55	1.00					
Age	0.08	0.06	0.08	0.33	1.00					
Exports	0.41	0.40	0.47	0.49	0.09	1.00				
Human capital	0.39	0.44	0.49	0.73	0.15	0.47	1.00			
Sindh	0.09	0.00	0.07	0.18	0.04	0.24	0.19	1.00		
Apparel	0.15	0.23	0.19	0.04	-0.02	0.32	0.08	-0.21	1.00	
ICT	0.36	0.34	0.42	0.52	0.17	0.48	0.48	0.19	0.11	1.00

Appendix-B:

Survey instrument, implementation and data reporting

The survey questionnaire was designed following the Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition (OECD, 2005)[9] and its recommendations for developing countries. A product innovation is defined as "the market introduction of a new or significantly improved good with respect to its capabilities, user friendliness, components/materials". A process innovation is the "implementation of a new or significantly improved production process, distribution method, or supporting activity".

The following core questions were asked related to innovation *output*:

During the three years from 2013 to 2015, did your enterprise introduce new or significantly improved goods (Yes/No)

> *If yes: Were any of your product innovations during the three years from 2013 to 2015 (i) New to your market (Yes/No)? (ii) Only new to your firm (Yes/No)?*

During the three years from 2013 to 2015, did your enterprise introduce

- *(i) New or significantly improved methods of manufacturing or producing goods (Yes/No);*
- *(ii) New or significantly improved logistics, delivery or distribution methods for your inputs, goods or services (Yes/No);*
- *(iii) New or significantly improved supporting activities for your processes, such as maintenance systems or operations for purchasing, accounting, or computing (Yes/No)?*

If yes: Were any of your process innovations introduced during the three years from 2013 to 2015 (i) New to your market? (ii) Only new to your firm?

Innovation is also measured as an activity, asking the *inputs* to the innovation process, in the following way:

During the three years from 2013 to 2015, did your enterprise engage in the following innovation activities (Yes/No) and Total expenditure of A-E in 2015(as % of sales):

- a. *In-house R&D? Continuously (your enterprise has permanent R&D staff in house)? occasionally (when needed)?*
- b. *External R&D*
- c. *Acquisition of (C1) Machinery purchases; (C2) Hardware purchases; (C3) Software purchases; (C4) Lease or rental of machinery, equipment?*
- d. *Acquisition of external knowledge*
- e. *Training for innovative activities*
- f. *Market introduction of innovations*
- g. *Other (including design)*

The entire questionnaire contains more detailed definitions of the various innovation outcomes and activities to help respondents make the right assessment.

[9] See http://www.oecd.org/sti/inno/oslo-manual-guidelines-for-collecting-and-interpreting-innovation-data.htm

Survey implementation

The survey was conducted in August-October 2015 and the innovation related questions were asked for the previous three fiscal years; 2013 (July 2012-June 2013), 2014 (July 2013-June 2014), 2015 (July 2014-June 2015). The Bureau of Statistics of Punjab and Sindh were recruited to implement the survey. A pool of 32 enumerators was selected by the bureaus of statistics. All enumerators were trained by the authors on survey instrument and implementation. At the end of the training, mock interviews were conducted to evaluate the knowledge of enumerators on the survey instrument and implementation. Authors selected the 19 (10 in Punjab and 9 in Sindh) best performing enumerators based on their knowledge of instrument, who were then taken to conduct the pilot surveys to further test the survey instrument. The survey instrument was first pre-tested by the authors in two firms, and was subsequently tested by the Bureaus of Statistics with the actual enumerators who each conducted test interviews in two firms in their respective province.

In person interviews were conducted with a knowledgeable person designated by firms at the level of manager or above. The questionnaire was printed in two languages (English and Urdu), and all responses were reported on the printed questionnaire. The statistics bureaus made a team of monitors to oversee the overall implementation of the survey. In addition, the authors also constituted a team of research assistants (Economics graduates) who randomly visited firms to ensure that enumerators were actually conducting interviews as per the protocol given to them such as surveying the actual firm, interviewing the knowledgeable person designated by the firm, and not influencing the respondents etc., and they prepared daily reports about their observations that were compiled by the project manager. As a first check, the authors used input from these daily reports to immediately contact enumerators/monitors and firms to confirm any reported irregularity. Secondly, the authors evaluated the actual filled questionnaires and would get back to the enumerators/firms in case of any anomaly. Finally, in order to ensure that the firms have actually participated in the survey, the authors contacted all firms by telephone to confirm their participation.

The data were then recorded using a pre-coded data entry program, which had in-built cross-checks to report any anomaly in the responses— including the typos and over/understatements. In case of outlier values, firms were contacted to ensure that the outliers were real. All the statistical analyses were performed using the Stata (v 14.2) software.

The UNU-MERIT WORKING Paper Series