Mobile Telephony and New Business Formation Rates in BRICs and Beyond: Does Human Capital Matter?

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Abstract

This study examines whether and to what extent 'domestic' education level mediates the relationship between mobile phone diffusion and new business formation rates across the developing world i.e. Brazil, Russia, India, China and South Africa (BRICs) and Non-BRICs Developing Countries. Drawing on Knowledge Spillover Theory of entrepreneurship, the paper posits that due to the recent rise in education in the developing world, mobile phone diffusion will be positively associated with new business formation rates, and education level will facilitate (mediate) the relationship. Utilising country-level panel data on 66 developing countries, the results suggest that education level is a mediator between mobile phone diffusion and new business formation rates not just in Developing Countries (Including BRICs) but also in Non-BRICs Developing Countries with the exception of least developed countries (LDCs). Implications are drawn for theory and policy.

Keywords: Entrepreneurship, New business formation rates, Human capital, Technology diffusion, Developing Countries, BRICS

1. Introduction

The analysis of the potential forces influencing entrepreneurship (defined as new business formation rates) across space has received much attention from the Knowledge Spillover Theory

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of Entrepreneurship (Acs et al., 2009; Audretsch and Keilbach, 2007; Acs et al. 2013; Shu &Liu, 2014; Tavassoli et al., 2017). The Knowledge Spillover Theory suggests that new business formation is a crucial contextual factor that is important for researchers and policymakers to understand, not just in developed countries but also in developing countries, as an important tool for stimulating growth and development (Acs and Virgill, 2010). From this perspective, new business formation and its context are vivid and virtually inseparable (Venkataraman, 1997; Morris et al., 2012; Qians et al, 2012). According to Li and Mitchell (2009) and Audretsch *et al.* (2006), Knowledge Spillover Theory takes the inseparability view of new business formation and context into account, suggesting that entrepreneurial opportunities are more likely to be generated in (1) contexts with higher levels of technology diffusion through networks; and that (2) education level can enhance the positive effects of technology on new business formation. As a result, the new business formation rates can vary across geographic regions, depending upon the context as determined by technology diffusion and education levels. Hence several studies particularly in developed countries have been carried out that examined the influence of education and technology diffusion (especially through networks) on new business formation rates (Acs and Armington, 2004; Abubakar and Mitra, 2007; Abubakar and Mitra, 2010; Agion and Jaravel, 2015). However, according to Acs and Virgill (2010: p.491) "while the Knowledge Spillover Theory of Entrepreneurship was intended for developed economies, the externalities (that is, education and networks of technology diffusion) identified by Audretsch et al. (2006) are valid for developing countries". Yet, very little research, if any, has examined the impact of these externalities on new business formation rates across the developing world. The limited research conducted suggests that returning Chinese and Indian migrant entrepreneurs from advanced countries like US, with their 'foreign' education are accelerating the process of technological diffusion and innovation in

their home countries particularly in information and communications technology (ICT) industries (Saxenian, 2002, 2005). However, to date, previous research has mainly focused on the relationship between education acquired by returning entrepreneurs from foreign countries and its impact on innovation mostly in BRICs related countries (BRICs - Brazil, Russia, India, China and recently South Africa). In contrast, the extent to which 'domestic' education level enhances the impact of technology diffusion on 'new business formation rates' across the developing world remains relatively unclear.

Accordingly, four major observations in developing countries (not only BRICs) provide the motivation for this study. First, in general, developing countries now have increasingly higher levels of education (UNDP, 2010: p.36). For example, on average, a person aged 15 or older in 1960 had less than 4 years of schooling; by 2010 this number had doubled globally and more than tripled in developing countries (from 1.9 years to 6.4) (UNDP 2010: p.36). Secondly, developing countries have the fastest growing mobile phone market in the world (GSMA, 2011; James, 2013; Pyramid research, 2015). Thirdly, published 'micro-level' case studies suggest that the diffusion of mobile phone in developing countries has led to the creation of several innovations and extraordinary large amounts of new businesses not only in BRICs (Stanley, 2005; Pyramid Research, 2010; Yang & Steensma, 2014; Wate, 2016). Fourthly, estimates suggest that mobile phone is having a considerable 'macro-level' impact on economic growth in developing countries (Deloitte, 2007; Kathuria et al., 2009; Qians, 2009). Taken together, these observations provide a strong motivation for one to investigate whether education level in a country enhances (mediate) the positive relationship between mobile phone diffusion and new business formation rates in developing countries (BRICs and beyond). Therefore, this paper raises the following questions: 1)

Across Developing Countries (including BRICs) in general, does level of education enhance (mediate) the relationship between mobile phone diffusion and new business formation rates?

2) ***In Non-BRICs Developing Countries, does level of education enhance (mediate) the relationship between mobile phone diffusion and new business formation rates?***

Consequently, this paper examines the questions in three key contexts of developing countries. These are: All Developing Countries (including BRICs), Non-BRICs Developing Countries and Least Developed Countries (LDCs). This allows one to examine whether the importance of education in mediating the relationship between mobile phone diffusion and new business formation rates in developing countries depends on inclusion of BRICs, or whether it matters in Non-BRICs developing countries and LDCs. The presentation of the paper is as follows. Section 2 of the paper outlines the Knowledge Spillover Theory of Entrepreneurship, with particular focus on technology diffusion and education as key factors that matter for new business formation rates across space. Section 3 develops a conceptual framework and hypotheses. The methodology is presented in section 4, and the findings in section 5. The final part presents the conclusion and implications for theory and policy

2. Theoretical Background: Knowledge Spillover Theory of Entrepreneurship

According to Breschi and Lissoni (2001: p.258), knowledge spillovers refer to: a) transfer of technology generated within innovative firms to other firms; b) technology that spills over is "freely" available or acquired at less than its original cost by those wishing to search it out (non-excludability), and can be used by many users at the same time (non-rivalry); c) notwithstanding b., technology ideas that spill over are more easily transferred through networks, which are often favoured by being located in the same geographical area; that is, knowledge spillover has a spatial

dimension (Tavassoli et al., 2017). These suggest that knowledge spillovers happen because knowledge can be transferred to non-investing parties. This implies that entrepreneurs and small firms especially when located close to key knowledge sources can acquire technological ideas more easily, thereby making the new business start-up process easier for spillover beneficiaries (Saxenian, 1994; Acs and Armington, 2004; Cassagande et al., 2016). According to Acs and Virgill's (2010), research works on the Knowledge Spillover Theory of Entrepreneurship identify technology diffusion through networks as important channel for knowledge spillovers.

3. Technology diffusion through geographic networks and its effect on new business formation rates in advanced economies

Technology diffusion generally describes the process whereby a product or service and the knowledge of its use and application move from a source, such as a large research and development (R&D) firm to a point of reception (for example entrepreneurs), which leads to commercialization often through new start-ups (Bozeman, 2000; Acs, 2002; Acs et al. 2013). A prominent feature of the Knowledge Spillover Theory is that technology diffusion particularly through geographic networks plays a crucial role in creating opportunities for budding entrepreneurs to create new businesses (Zucker et al., 1998; Stuart and Sorenson, 2003; Acs et al. 2009; Yang and Steensma, 2014). Consider for example Silicon Valley where the diffusion of internet technology created opportunities for new business formation by countless entrepreneurs, such as Jerry Yang (Yahoo), Larry Page and Sergey Brin (Google Inc.), Marc Pincus (Zynga), Aron Levie (Box) etc. This diffusion of technology according to Knowledge Spillover Theory into new businesses often occurs in spatially bounded networks (Saxenian, 1994; Abubakar, 2013; Tavassoli et al. 2017). This is because entrepreneurs often find it easier to leverage social ties necessary to mobilize

essential resources and knowledge when they reside close to the source of the knowledge that spills over (Stuart and Sorenson, 2003; Yang and Steensma,2014). Thus, in advanced economies, technology diffusion particularly through networks has emerged as a major research topic in the literature on knowledge spillovers (Saxenian, 1994; Stuart and Sorenson, 2003; Shu et al. 2014). It is ill known in the Knowledge Spillover theory that technology differences explain a significant part of the variation observed across space in the rates of new business formation (Zucker *et al*., 1998; Tavassoli et al. 2017). This implies that a major determinant of new business formation is technology diffusion in a region or country. This raises the question: what factor affects the rate at which technology diffuses through new business formation in a society? This is an important question that should concern researchers today, because it is a question that matters for policy makers trying to encourage the spread of technology and its impact on new business formation, as a means of creating opportunities budding entrepreneurs.

4. The role of education as a mediator between technology diffusion and new business formation in advanced economies

Scholars for a long time argue that the diffusion of technologies often requires human capital in the form of education (Abromovitz, 1986; Cohen and Levinthal, 1989; Cosar, 2011; Qian et al., 2012). Nelson and Phelps (1966) initiated this line of thinking by arguing that education helps people to perceive, evaluate and implement new production techniques and inputs. Human capital refers to an individual's stock of education, experience, skills and intelligence (Mitra *et al*., 2011). Knowledge Spillover Theory suggests that education can make individuals start new businesses by enabling them to exploit technological opportunities (Audretsch *et al*., 2006; Acs and Virgill, 2009; Yang and Steensma,2014). This is because education often gives individuals a feeling of

autonomy, and the necessary skills to be able to develop technological opportunities (Acs, 2002; Verheul et al., 2002; Qian et al, 2012; Acs et al., 2013). Particularly in advanced economies, there is empirical support for this approach. For example, at the micro-level in Italy, a study by Colombo et al. (2004) finds that founders' educational background has a crucial influence on entrepreneurs' ability to start-up technology-based new businesses. At the regional level, a study by Zucker et al. (1998) finds that the rise of new biotechnology businesses in the U.S. is intertwined with educational human capital. And in United Kingdom (UK), based on county-level data on information and communications technologies (ICT) sector of East of England, Abubakar and Mitra (2007) found that networks between university and industry influence new business formation rates across space. And even beyond new businesses, a study by Doms et al. (1997) on manufacturing plants in the U.S. finds that plants with a higher proportion of workers with higher levels of education tend to use more advanced technologies. Thus, research suggests that educational levels can enhance or mediate the relationship between technology diffusion and formation of new businesses. Yet, despite this ill recognized role, Knowledge Spillover research does not satisfactorily explain whether educational levels also mediate the relationship between technology diffusion and new business formation rates in developing countries. Nonetheless, as pointed out by Acs and Virgill (2010), although Knowledge Spillover Theory was intended for developed economies, the externalities (that is human capital and technology diffusion through networks), identified by Audretsch *et al.* (2006) may be valid for developing countries. Thus, in the next section, this paper will review studies on knowledge spillovers in developing countries (which largely focus only on innovation not new business formation rates).

5. Conceptual Framework and Hypotheses: Educational Level as a Mediator between Technology Diffusion and New Business Formation Rates in Developing Countries

Although there is a growing interest in the importance of education and its role as a catalyst in influencing technology based entrepreneurship in developing countries (Acs and Virgill, 2010), there is currently only a limited number of studies on the topic in developing countries, most of which focus mainly on 'innovation' rather than 'new business formation rates' (see Table 1 for a summary). Thus, although progress has been made, there is still a lack of macro-level empirical studies on mediating role of level of education in the relationship between technology diffusion and new business formation rates across developing countries.

Table 1: Previous Research on Knowledge Externalities and Innovation in Developing Countries

Author(s)	Contribution	Gaps
Cassgrande et al. (2016)	+ve knowledge spillover affects innovation sustainability in complex capital system like Brazil.	1,2
Filatotchev et al (2011)	+ve knowledge spillover effects are associated with returnee entrepreneurs	1,2
Watu (2009)	+ve role of knowledge spillovers on development in China	1,2
Kesidou and Romijn (2008)	+ve effect of knowledge spillovers on firms' innovation (particularly through labour mobility, company spin-offs, and networks among innovation actors)	1,2
Kesidou and Szirmai (2008)	+ve effect of knowledge spillovers on innovation by Software firms	1,2
Saxenian (2005)	+ve effect of transnational entrepreneurs on innovation in Taiwan, China and India	1,2
Saxenian (2002)	+ve effect of transnational entrepreneurs on innovation in China and India	1,2

1) Not focused on new business formation rates in developing countries;
2) 2) Does not investigate whether human capital mediates the link between mobile phone diffusion and new business formation in developing countries.

This section there develops a conceptual framework for examining the extent to which educational level mediates the relationship between technology diffusion and new business formation rates in developing countries (that is including BRICs) and beyond BRICs. Thus, the framework is

developed in three contexts of developing countries, that is All Developing Countries (Inc. BRICs), Non-BRICs Developing Countries and LDCs.

6. The research settings: developing countries

Developing countries are defined as low and middle-income countries (World Bank 2012). The World Bank definition is based on gross national income (GNI) per capita, with low-income countries being those with $1,025 or less and middle-income countries being those with $1,026 - $12,475. Thus, the term 'developing countries' encompasses a diverse group of countries that include leading emerging economies such as BRICs and Next 11 and other least developed countries, known as LDCs. BRIC refers to 'large developing countries' (Goldman Sachs, 2003: p.3) with the potential for growth in the coming few decades, to 'become a much larger force in the world economy' (Goldman Sachs, 2003: p.3)[i].

However, beyond BRICs (that is in Non-BRICs developing countries), there are other emerging economies popularly known as the Next-11 (Goldman Sachs, 2007), some of which are also beginning to emerge as key off-shoring destinations, such as Egypt, Mexico and Philippines (CGGC, 2010). The Next-11 is made-up of: Bangladesh, Egypt, Indonesia, Iran, South Korea, Mexico, Nigeria, Pakistan, the Philippines, Turkey and Vietnam (Goldman Sachs, 2007). While the Next-11 may not have the BRICs like impact, they also have the characteristics of rapidly growing populations combined with significant industrial capacity or potential (Goldman Sachs, 2007). Also, among the Non-BRICs Developing Countries, there are poorly developed countries such as LDCs. LDC is defined as a country that meets three criteria (UNCTAD, 2011): a) low-income[ii] (b) human asset iakness[iii](c) economic vulnerability[iv]. Therefore, these are countries characterized by very challenging economic environments (UNCTAD, 2011).

7. Mobile phone diffusion, externalities and new business formation

This paper focuses specifically on mobile phone diffusion (as a form of technology diffusion) because mobile phones are among the most widely spread technologies in developing countries (Pyramid Research, 2010), and have huge influence on economic outcomes in developing countries (Waverman, *et al*., 2005; Qiang, 2009). As mobile phone diffusion grows, its value to the society and economy also increases (Waverman *et al.*, 2005). This is because, the more people connect to a communication network, the more such diffusion creates opportunities for budding entrepreneurs to start new businesses in the sector (Aker and Mbiti, 2010; Agion and Javarel, 2015) and access information, markets, and services faster, which in turn often boosts economic activities and growth (Waverman, *et al.*, 2005). Therefore, several macro-level studies have examined the economic impact of mobile phones on developing countries and found it to be positive and significant (Waverman et al., 2005; Qiang, 2009: see Table 2 for a summary).

Table 2: Empirical Studies: Mobile Phones and Economic Performance in Developing Countries

Author	Context	Findings	Gaps
West and Chew (2014)	16 Sub-Saharan African countries	Mobile phones positively impacts reading in developing countries.	1,2
James (2013)	11 African countries	Mobile phones usage patterns positively enhance economic growth and individual's lives in the face of poor infrastructural facilities.	1,2
Blauw and Franses (2011)	Uganda	Mobile phone positively impacts economic development	1,2
Delloite (2009)	Sudan	6 percent increase in mobile penetration is associated with 0.72 percent of Sudan's increase in total GDP	1,2
Barberousse, Bernard and Pescatori (2009)	Haiti	Mobile phone development is an engine for economic growth	1,2
Djiofack and Keck (2009)	177 countries, 45 of which are Sub-Saharan	1 percent increase in access to mobile phones is associated with 0.5 percent increase in real GDP per capita	1,2
Qiang (2009)	120 developing and developed countries	For 10 percentage increase in penetration of mobile phones, economic growth increases by 0.81 percentage in developing countries, versus 0.60 in developed countries	1,2

Kathuria, Uppal and Mam (2009)	Indian states	States with higher mobile penetration can be expected to grow faster	1,2
Muto and Yamano (2009)	Uganda	Mobile phone coverage expansion induces market participation of farmers in remote areas	1,2
Sridhar and Sridhar (2007)	63 developing countries	Mobile phones contribute positively to national output	1,2
Waverman, Meschi and Fuss (2005)	92 developing and developed countries	Impact of mobile telephony on GDP of developing countries is twice that of developed countries	1,2

1) Does not examine at the macro-level whether mobile phone diffusion is positively associated with new business formation 'rates' across developing countries;

2) Does not investigate whether level of education mediates the link between mobile phone diffusion and new business formation rates in developing countries.

In this context, one of the major ways in which mobile phone diffusion impacts on developing countries is through new business formation (Aker and Mbiti, 2010; James, 2013). This is because large mobile phone companies in developing countries create indirect job opportunities for budding entrepreneurs by giving them opportunity to start new businesses, such as third party application developers, content providers, recharge card sellers, phone repairers and call center operators (Pyramid Research, 2010; Andjelkovic and Imaizumi, 2012: see Table 3 for examples).

Table 3: Micro-Level Case Studies Linking Mobile Phone Diffusion Networks between Mobile Phone Corporations and Local Entrepreneurs with New Business Formation In Developing Countries

Author(s)	Country	Networks between Mobile phone corporations and local entrepreneurs	Impact on New Business Formation	Gaps
GSMA (2017)	Bangladesh	Mobile phone network operators impact on micro-entrepreneurs and other indirect employment	In 2015, mobile phone in Bangladesh generated up to 520,000 indirect jobs and 195,000 informal jobs	1,2
GSMA (2015)	Pacific Islands	Mobile phone network operators impact on micro-entrepreneurs and other indirect employment	In 2014 about 15,000 jobs were indirectly supported	1,2 1,2
Sey (2011)	Ghana	In 2004, Spacefon *(now MTN Ghana)* cooperated with local entrepreneurs aimed at penetrating low-income markets.	By 2008, over 25,000 operators had been established by local entrepreneurs	1,2

UN (2010)	Banglades h	Grameen started supporting local entrepreneurs in 1997 to set-up phone operating business in Bangladesh targeting loir income markets	By 2008, there ire over 350,000 phone operators created by entrepreneurs	1,2
Pyramid Research (2010)	Nigeria	Operators of mobile services in Nigeria have distribution networks with local entrepreneurs.	By 2010, local entrepreneurs had generated over 3 million indirect employment related to mobile services.	1,2
	Uganda	In 2003, Grameen Foundation, MTN etc launched Village Phone Uganda to promote connectivity and entrepreneurship for the poor.	By 2010 a total of about 35,000 active phone operators had emerged, 16,397 of which relate to village phone program.	1,2
	South Africa	*Vodacom*, supplies community phones to shops run by local businesses under franchise.	By 2010, a total, of 22,000 entrepreneur phone shops ire established.	1,2
	Kenya	Safaricom in Kenya targeted low-income markets with M-PESA mobile money transfer.	The MPESA agent network expanded dramatically, reaching about 18,000 by April 2010.	1,2
World Resources Institute (2007)	Philippines	*Smart Communications and Globe Telecom:* created financial innovations that allow people to transfer cash from Bank to cell phone.	By 2007, over 1.5 million new entrepreneurs and shops had been created, helping customers with voice messaging	1,2

1) Does not examine at the macro-level whether mobile phone diffusion is positively associated with higher network externalities in terms of new business formation 'rates' across developing countries; 2) Does not investigate whether human capital mediates the link between mobile phone diffusion and new business formation rates in developing countries.

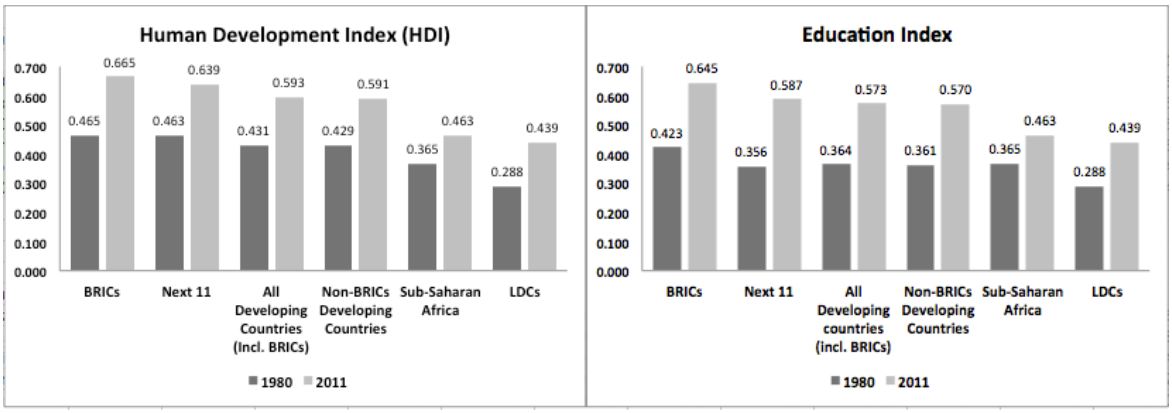
However, although the above studies (in Table 3) make significant contributions to our understanding of the influence of mobile phones on new business formation at the micro-level (Pyramid Research, 2010, 2015,2016; Sey, 2010; Rao, 2011) and the impact of mobile phones on economic performance in developing countries at the macro-level (Waverman, *et al.* 2005; Qiang, 2009), none of the studies investigates the extent to which level of education matters in the relationship between mobile phone diffusion and new business formation rates in developed

countries at the macro-level. Yet, education may matter, especially because the Knowledge Spillover Theory suggests that an educated populace is more likely to have the ability to exploit technologies for new business formation (Zucker *et al*., 1998; Audretsch, *et al.*, 2006; Acs et al., 2009).

As shown in Figures 1a and b, there is a general rise in education across developing countries, with BRICs and Next 11 having higher levels than the average for All Developing Countries in both Human Development Index (HDI) and Education Index. Among the three main groups that form the focus of this study, the group All Developing Countries (Including BRICs) has the highest level of both HDI and Education Index, folloid by the Non-BRICs Developing Countries and then LDCs.

Figure 1: Human Development Index & Education Indexes – 1980-2011 (Average)

(a) (b)



Note: The focus of this study are mainly: All Developing Countries Including BRICs), Non-BRICs Developing Countries and LDCs.

Source: UN Human Development Index (UNDP, 2012)

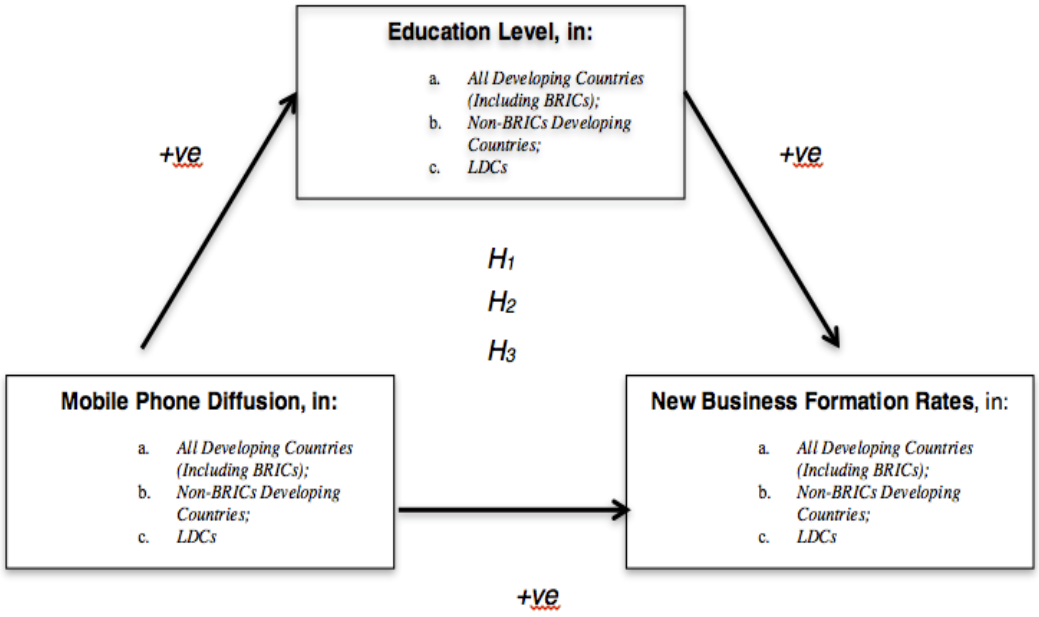
Therefore, considering that: 1) micro-level case studies suggest that mobile phone diffusion has positive externalities for new business formation in developing countries on a large scale (World Resources Institute, 2007; Pyramid Research, 2010; Acs et al., 2013); and 2) mobile phone diffusion is enhanced by level of education (Abromovitz, 1986; Cohen and Levinthal, 1989; Cosar, 2011); and 3) that education is significantly related to new business formation rates (Zucker *et al.*, 1998; Acs and Armington, 2004; Abubakar and Mitra, 2007), we argue that this proposition is likely to hold not just for BRICs but also Non-BRICs developing countries, considering that there are rising levels of education across developing countries in general even beyond BRICs (UNDP, 2012). Therefore, based on the above, I put forth 3 hypotheses to test the central proposition (Figure 2 depicts the hypothesized relationships):

H₁: In Developing Countries (including BRICs), *Mobile Phone Diffusion* will be positively related to *New Business Formation Rates* and Education Level mediates this relationship.

H₂: In Non-BRICs Developing Countries, *Mobile Phone Diffusion* will be positively related to *New Business Formation Rates* and *Education Level* mediates this relationship.

H₃: In LDCs, *Mobile Phone Diffusion* will be positively related to *New Business Formation Rates* and *Education Level* mediates this relationship.

Figure 2: Conceptual Framework of the Study



8. Methodology

Sample selection

Panel data set was used to test the hypotheses. The sample under study is made-up of developing countries for which data is available on new business formation rates from *World Development*

Indicators (WDI, 2012). Developing countries are defined based on World Bank's classification of low-income countries (those with $1,025 or less) and middle-income countries (those with $1,026 - $12,475.) as developing countries. The sample was selected based on the following criteria: 1) developing countries, that is low and middle-income countries (this ensures that only developing countries are selected); 2) having data on new business formation rates (so as to ensure that an acceptable measure of entrepreneurship is employed) (Acs and Armington, 2004). Based on the above criteria, a sample of 66 developing countries (out of a total of 144 developing countries) was generated, for which data is available on new business formation rates 2005 – 2009 from WDI (2012). Thus, the sample represents 46 percent of the total population of developing countries. The sample is further divided into the following groups: All Developing Countries (Including BRICs)[v], Non-BRICs Developing Countries[vi] and LDCs[vii].

8.1 The dependent variables

New Business Formation Rates: The dependent variable for this study is a measure of the national rates of new business formation as measured by the number of new businesses registered per working age population in the formal sector (Acs and Armington, 2004; World Bank, 2010). The data is drawn from WDI (2012), which provides panel data on the number of limited liability firms registered for the first time between 2005 and 2009 (WDI, 2012). The study is limited to new business registration in the formal sector, not only because of lack of cross-country data on informal sector business start-ups (World Bank, 2010) but also because of advantages of formal sector participation, which include greater high-growth potentials (Schneider and Enste, 2000; World Bank, 2010).

8.2 The independent and mediator variables

Mobile Phone Diffusion: To measure mobile phone diffusion across countries, this paper uses data on mobile cellular subscriptions (per 100 people) from 2005-2009 (WDI, 2012). These are subscriptions made for mobile phone services based on cellular technology that gives access to the public switched telephone network (WDI, 2012).

Education Level: To measure the level of education in each country, this study uses the UN Education index, which is one of the most recognized measures of education level across countries. This measures the mean of years of schooling for adults aged 25 years and also expected years of schooling for children of school entering age. The data for the Education index was obtained from UNDP's Human Development Index for the years 2005-2009 (UNDP, 2012).

8.3 Analytic Methods and Controls: other factors that may affect new business formation rates in different developing economy contexts

Baron and Kenney's (1986)[viii] test of mediation and Sobel's (1982)[ix] Test of indirect effects ire used for the analysis in order to ensure robust results. In order to ensure rigorous tests of the hypothesized relationships, this study uses a range of control variables on other factors that may affect new business formation rates in different developing economy contexts. Since the number of new businesses in each geographical area or country would tend to be proportional to the size of the area (Acs and Armington, 2004), control is applied for the size of country by using numbers of new businesses 'per working age population' (WDI, 2012). Other controls include: *working age population*[x] (Acs and Armington, 2004: p.250), *Migrant Returnees from Developed Countries*[xi]

(Saxenian, 2005), *University Research*[xii] (Audretsch, Lehmann and Warning, 2005), *Population Growth*[xiii] (Acs and Armington, 2004), *Economic Growth*[xiv] (Wong, Ho and Autio, 2005) and *Foreign Direct Investment*[xv] *(FDI)* (Fu, 2008).

8.4 Descriptive Statistics

Table 4 presents descriptive statistics for the key variables. The results reveal some important findings in relation to the key variables (that is *New business formation rates, Mobile phone diffusion rates* and *Human Capital*). First, the full sample containing ALL DEVELOPING COUNTRIES (INC. BRICS) has only slightly higher values than the sample containing NON-BRICS DEVELOPING COUNTRIES in relation to the key variables. Thus, although the ALL DEVELOPING COUNTRIES (INC. BRICS) sample appears to have slighter higher values, the difference does not appear to be much, in comparison to the NON-BRICS DEVELOPING COUNTRIES sample. This is likely because of the existence of other emerging economies such as the Next11 in the NON-BRICS DEVELOPING COUNTRIES sample. Secondly however, the sample containing LDCs appears to have significantly loir values in comparison to ALL DEVELOPING COUNTRIES (INC. BRICS) in all the key variables (that is *New Business Formation Rates, Mobile Phone Diffusion* and *Human Capital*). This suggests considerably loir levels of *New Business Formation Rates, Mobile Phone Diffusion Rates* and *Human Capital* in LDCs.

Table 4: Key Variables: Summary Statistics for developing countries

	ALL DEV. COUNTRIES (INC. BRICS)			NON-BRICS DEV. COUNTRIES			LDCs		
	Obs.	**Mean**	**S.D.**	***Obs.***	**Mean**	**S.D.**	***Obs.***	**Mean**	**S.D.**
New Business Formation Rates	317	1.8315	2.35147	298	1.8254	2.39544	64	.7942	1.42972
Mobile Phone Diffusion Rate	325	63.7149	39.56118	305	63.0114	39.43357	65	23.6761	29.74651
Education Level	310	.6257	.16527	290	.6248	.16753	55	.3749	.13013
GDP Growth	330	5.1531	5.39840	310	5.1710	5.47036	65	6.6120	4.44473
Population Growth	330	1.2145	1.08715	310	1.2400	1.10411	65	2.5419	.67489
Scientific and Technical Journal Articles	325	25.6812	33.58535	310	24.1141	32.75131	65	3.9835	3.65166
FDI, Net Inflows	323	3.9907E9	8.43611E9	308	2.6233E9	4.47590E9	65	3.0721E8	3.33341E8
Migrant Returnees from Developed Countries	325	.4066	.68537	310	.4205	.69861	65	.0819	.11473

Results: Testing for Mediation Using Baron and Kenney Procedure

Step One

First, based on Baron and Kenney's (1986) procedure, the relationship between *Mobile Phone Diffusion* (independent dependent variable) and *New Business Formation Rates* (dependent variable) is investigated. Therefore, the standardised regression coefficient (beta) is assessed to determine the size of the relationship and whether it is significant. I employ several control variables, and the analysis for each research context is carried-out separately. If this association is not significant, there is no mediation as there is no relationship to mediate. Different results are presented in Table 5 for ALL DEVELOPING COUNTRIES (INC. BRICS) and NON-BRICS DEV. COUNTRIES and LDCs based on Baron and Kenney's Step 1 procedure for testing mediation (Baron and Kenney's, 1986; Zhu, Chew and Spranger, 2005). The Table shows the Adjusted R^2 for ALL DEVELOPING COUNTRIES (INCLUDING BRICS) *(Adj.* R^2 =.147*)* and

NON-BRICS DEVELOPING COUNTRIES *(Adj. R^2* =.137) and LDCs *(Adj. R^2* =.440*).* Although only a small amount of variance is explained in *New Business Formation Rates* by *Mobile Phone Diffusion*, this Table shows that the relationship is significant for ALL DEVELOPING COUNTRIES (INCLUDING BRICS) *(*F = 11.231, p <.001*)* and NON-BRICS DEVELOPING COUNTRIES (F = 10.045, p <.001); and LDCs (F = 10.820, p <.001). Thus, in all the three contexts, the relationship between *Mobile Phone Diffusion* (independent dependent variable) and *New Business Formation Rates* (dependent variable) appears to be significant.

Table 5: Mobile Phone Diffusion and New Business Formation Rates in Developing Countries

	ALL DEVELOPING COUNTRIES (INCLUDING BRICS)	**NON-BRICS DEVELOPING COUNTRIES**	**LDCs**
	New Business Formation Rates *(Model 1)*	**New Business Formation Rates** *(Model 1)*	**New Business Formation Rates** *(Model 1)*
Mobile Phone Diffusion	.185** (2.788)	.178*** (2.629)	.418*** (3.353)
Education Level			
GDP Growth	.064 (1.219)	.060 (1.108)	.418*** (3.353)
Population Growth	-.103 (-1.530)	-.096 (-1.401)	.087 (.933)
Scientific And Technical Journal Articles	.046 (.705)	.037** (.557)	-.087 (-.829)
FDI, Net Inflows	-.002 (-.046)	-.044 (-.817)	-.066 (-.711)
Migrant Returnees From Developed Countries	.188*** (3.191)	.200*** (3.292)	-.097 (-.756)
Constant	(2.215)*	(2.273)*	(.015)
F	11.231***	10.045***	10.820***
Obs.	358	342	76
Adjusted R^2	.147	.137	.440

[+]Sig. at the 0.1 level; *Sig. at the 0.05 level; **Sig. at the 0.01 level; ***Sig. at the 0.001 level (2-tailed)

Step Two

Second, the relationship between *Mobile Phone Diffusion* and *Education level* is tested and the beta examined for its size, its direction and significance. Again, many control variables are employed and each research context is analysed separately. If this relationship is not significant, then the hypothesised role of Education Level as a mediator cannot hold. Table 6 below presents the results. Separate results are presented for ALL DEVELOPING COUNTRIES (INC. BRICS) and NON-BRICS DEVELOPING COUNTRIES and LDCs. This is based on Baron and Kenney's Step 2 procedure for analysing mediation (Baron and Kenney's, 1986; Zhu, Chew and Spranger, 2005). Table 6 depicts the Adjusted R^2 for ALL DEVELOPING COUNTRIES (INCLUDING BRICS) *(Adj. R^2 =.584)* and NON-BRICS DEVELOPING COUNTRIES *(Adj. R^2 =.582)* and LDCs *(Adj. R^2 =.486).* The findings suggest that *Mobile Phone Diffusion* is significantly related to the *Education Level* for ALL DEVELOPING COUNTRIES (INCLUDING BRICS) *(F = 71.751, p <.001)* and NON-BRICS DEVELOPING COUNTRIES (F = 67.710, p <.001); and LDCs (F = 9.507, p <.001). Therefore, in all the research contexts, the relationship between *Mobile Phone Diffusion* and *Education level* appears to be significant.

Table 6: Mobile phone diffusion is significantly related to the Education Level in Developing Countries

	ALL DEVELOPING COUNTRIES (INCLUDING BRICS)	**NON-BRICS DEVELOPING COUNTRIES**	**LDCs**
	Education Level *(Model 1)*	**Education Level** *(Model 1)*	**Education Level** *(Model 1)*

Mobile Phone Diffusion	.244***	.223***	.406*
	(4.745)	(4.268)	(2.211)
GDP Growth	-.007	-.005	.016
	(-.167)	(-.128)	(.158)
Population Growth	-.575***	-.592***	-.433***
	(-11.020)	(-11.116)	(-3.448)
Scientific And Technical Journal Articles	.060	.038	.301*
	(1.231)	(.780)	(2.344)
FDI, Net Inflows	-.036	.059	.363***
	(-.902)	(1.468)	(3.636)
Migrant Returnees From Developed Countries	-.019	-.023	-.315
	(-.433)	(-.503)	(-1.669)
Constant	(26.664)***	(26.228)***	(5.915)***
F	71.751***	67.710***	9.507***
Obs.	303	288	55
Adjusted R^2	.584	.582	.486

[+]Sig. at the 0.1 level; *Sig. at the 0.05 level; **Sig. at the 0.01 level; ***Sig. at the 0.001 level (2-tailed)

Steps Three and Four

Finally, a hierarchical regression is performed in two steps. At Step Three of Baron and Kenney, the association between *Education Level* and *New Business Formation Rates* in Developing Countries is examined in the three research contexts. At Step Four, the relationship between *Mobile Phone Diffusion* and *New Business Formation* (tested earlier in Step One above) is examined again.

Partial vs. full mediation: The beta for Step Four is now examined. If *Education Level* is indeed a mediator, then the significant association between *Mobile Phone Diffusion* and *New Business Formation* observed in Step One (above) should no longer be significant. But if the regression coefficient is considerably reduced at the final step, but remains significant, then that implies

partial mediation. Table 7 shows the two-step analysis. For ALL DEVELOPING COUNTRIES (INCLUDING BRICS), at Step Three, *Education Level* explains 26.4 percent of the variance in *New Business Formation Rates* (p<0.001). At Step Four, the effect of *Mobile Phone Diffusion* is reduced to only being significant at (p <0.1). Therefore, the final step suggests partial mediation for ALL DEVELOPING COUNTRIES (INCLUDING BRICS). For NON-BRICS DEVELOPING COUNTRIES at Step Three, *Education Level* explains 26.9 percent of the variance in *New Business Formation Rates* (p<0.001). At Step Four, the effect of *Mobile Phone Diffusion* is reduced to only being significant at (p <0.1). Therefore, the final condition for establishing partial mediation has also been met for NON-BRICS DEVELOPING COUNTRIES. For LDCs at Step Three, *Education Level* explains 37.7 percent of the variance in *New Business Formation Rates* (p<0.001). At Step Four, *Mobile Phone Diffusion* still adds significantly to the variance explained (p<0.001). Therefore unlike the other research contexts, for LDCs the final condition for establishing mediation has 'not' been met (see Figure 3a, b and c for a summary of empirical results).

Table 7 Education Level as Mediator between Mobile Phone Diffusion and New Business Formation Rates in Developing Countries

	ALL DEVELOPING COUNTRIES (INCLUDING BRICS)		**NON-BRICS DEVELOPING COUNTRIES**		**LDCs**	
	Education Level *(Step 1)*	**New Business Formation** *(Step 2)*	**Education Level** *(Step 1)*	**New Business Formation** *(Step 2)*	**Education Level** *(Step 1)*	**New Business Formation** *(Step 2)*
Mobile Phone Diffusion		.148+ (1.927)		.141+ (1.819)		1.091*** (10.087)
Education Level	.264***	.221**	.269**	.229** (2.631)	.377**	.096 (1.140)

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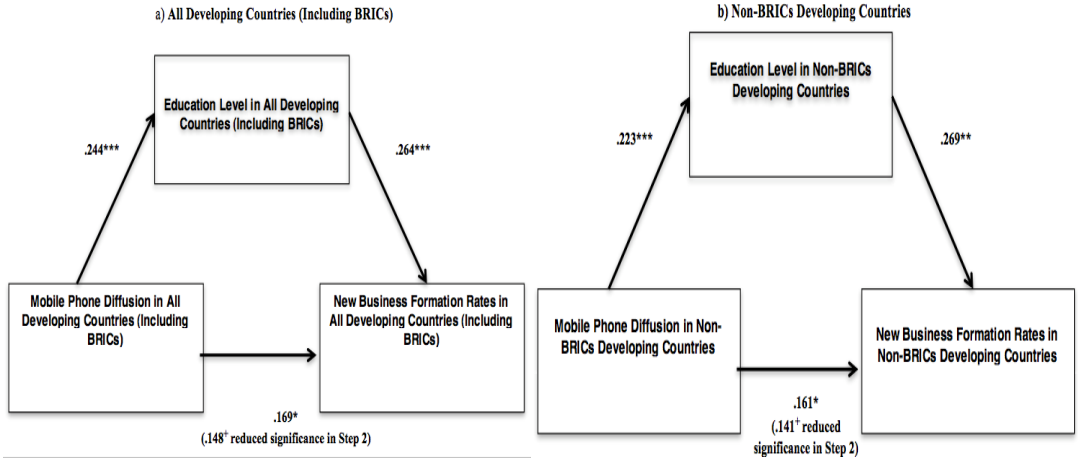
	(3.218)	(2.604)	(3.170)		(2.662)	
GDP Growth	.072 (1.318)	.106+ (1.847)	.071 (1.264)	.102 (1.745)	.058 (.585)	.195** (3.366)
Population Growth	-.029 (-.332)	.003 (.029)	-.012 (-.133)	.020 (.221)	-.155 (-1.118)	-.045 (-.569)
Scientific And Technical Journal Articles	.050 (.707)	.019 (.271)	.042 (.603)	.014 (.200)	.119 (.876)	.131+ (1.720)
FDI, Net Inflows	.008 (.137)	.003 (.047)	-.058 (-.983)	-.061 (-1.039)	-.182 (-1.587)	-.120+ (-1.845)
Migrant Returnees From Developed Countries	.202** (3.167)	.195* (3.067)	.216*** (3.278)	.210** (3.186)	.325* (2.269)	-.404*** (-3.726)
Constant	(-1.023)	(-1.306)	(-1.019)	(-1.313)	(-.350)	(-1.275)
Obs.	291	291	277	277	54	54
Adjusted R^2	.170	.178	.162	.169	.506	.843
R Square	.187	.198	.180	.190	.562	.864
R Square Change	.187	.011	.180	.010	.562	.301
F Change	10.888***	3.714+	9.899***	3.309+	10.060***	101.757***

+Sig. at the 0.1 level; *Sig. at the 0.05 level; **Sig. at the 0.01 level; ***Sig. at the 0.001 level (2-tailed)

Figure 3: Summary of Empirical Results

(a) (b)



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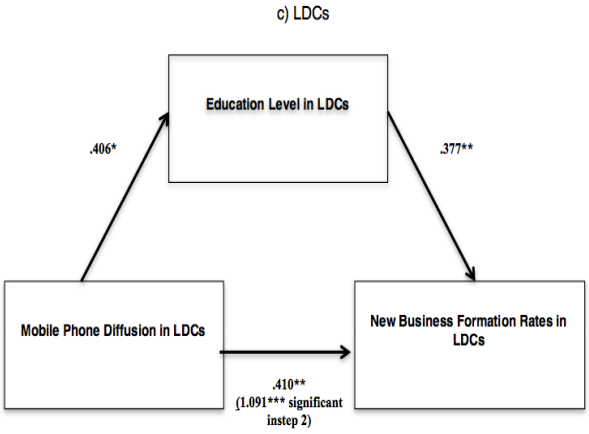
(c)



9. Conclusions and Implications

This paper examines the extent to which *Education level* mediates the relationship between *Mobile phone diffusion* and *New business formation* rates in three contexts: ALL DEVELOPING COUNTRIES (INCLUDING BRICS), NON-BRICS DEVELOPING COUNTRIES and LDCs. The analysis contributes to the Knowledge Spillover Theory of entrepreneurship in developing countries in at least three important ways. First, it suggests a macro-level association (for the first time) between a developing country's level of technology that is, *Mobile phone diffusion* and the country's *New business formation rates*. Secondly, the paper suggests that although the relationship between *Mobile phone diffusion* and *New business formation rates* in developing countries is partially mediated by *Education level* in ALL DEVELOPING COUNTRIES (INCLUDING BRICs) and NON-BRICS DEVELOPING COUNTRIES. In contrast, the role of *Education Level* as a mediator of the relationship does not appear to be significant in LDCs. Thirdly, the empirical analysis is based upon rigorously collected authoritative multi-country data from WDI that ansirs the concern voiced by researchers for the dearth of macro-level empirical

research on viability of Knowledge Spillover Theory across developing countries (Acs and Virgill, 2010).

The policy implications are: 1) that governments in BRICs and Non-BRICs developing countries may need to consider developing appropriate policies for encouraging mobile phone corporations to network with local entrepreneurs, which can result in more opportunities for new business formation for local entrepreneurs; 2) mobile phone start-ups in LDCs may simply be non-knowledge-based mobile start-ups, which contrasts with those in emerging economies, that is BRICs and Next11 where education appears to significantly matter.

References

Abubakar, Y. A., & Mitra, J. (2009). Innovation performance in European regions: comparing manufacturing and services ICT subsectors. *International Journal of Entrepreneurship and Innovation Management, 11*(2), 156-177.

Abubakar, Y., & Mitra, J. (2007). Developing a Culture for Entrepreneurship in the East of England The Value of Social and Human Capital. *Industry and Higher Education, 21*(2), 129-143.

Abubakar, Y. A., & Mitra, J. (2013). The Venturesome Poor and Entrepreneurial Activity in Nigeria The Role of Consumption, Technology and Human Capital. *The International Journal of Entrepreneurship and Innovation, 14*(4), 235-254.

Acs, Z. J., & Armington, C. (2004). The impact of geographic differences in human capital on service firm formation rates. *Journal of Urban Economics*, *56*(2), 244-278.

Acs, J. Z., Audretsch, D.B.,Erik, E and Lehmann, E.E.(2013). Knowledge theory of entrepreneurship. *Small Business Economics,* 41(4), 757-774.

Acs, Z. J., Braunerhjelm, P., Audretsch, D. B., & Carlsson, B. (2009). The knowledge spillover theory of entrepreneurship. *Small business economics*, *32*(1), 15-30.

Acs, Z. J., and Virgill, N. (2010). *Entrepreneurship in developing countries*. Hanover, Mass.: Now.

Yazid Abdullahi Abubakar, Jay Mitra & Adeyeye, Mercy Modupe (2018) Mobile telephony and new business formation rates in BRICS and beyond: Does human capital matter? Journal of Entrepreneurship and Innovation in Emerging Economies, 4(2)137-148.

Aghion, P., & Jaravel, X. (2015). Knowledge spillovers, innovation and growth. *The Economic Journal*, *125*(583), 533-573.

Aker, J. C., & Mbiti, I. M. (2010). Mobile phones and economic development in Africa. *The Journal of Economic Perspectives*, *24*(3), 207-232.

Andjelkovic, M., and Imaizumi, S. (2012). Mobile Entrepreneurship and Employment. In World Bank (Ed.), *Information and Communications for Development: Maximizing Mobile* (pp. 73-84). Washington, DC: World Bank.

Audretsch, D. B., & Keilbach, M. (2007). The theory of knowledge spillover entrepreneurship. *Journal of Management Studies*, *44*(7), 1242-1254.

Audretsch, D. B., Keilbach, M. C., & Lehmann, E. E. (2006). *Entrepreneurship and economic growth*. Oxford University Press.

Audretsch, D. B., Lehmann, E. E., & Warning, S. (2005). University spillovers and new firm location. *Research policy*, *34*(7), 1113-1122.

Bania, N., Eberts, R. W., & Fogarty, M. S. (1993). Universities and the startup of new companies: can we generalize from route 128 and Silicon valley?. *The review of economics and statistics*, 761-766.

Barberousse, G., Bernard, T., & Pescatori, V. (2009). The economic impact of the development of mobile telephony: Results from a case study in Haiti. *Proparco's Magazine*, *4*, 26-30.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology*, *51*(6), 1173.

Blauw, S. L., and Franses, H. P. (2011). The Impact of Mobile Telephone Use on Economic Development of Households in Uganda. Tinbergen Institute Discussion Paper.

Casagrande, R.M., Macke, J. and Sarate, J.O.A (2016). Knowledge Cities and Sustainable Innovation in Developing Countries. 22nd International Sustainable Development Research Society Conference, School of Science and Technology, Universidade Nova de Lisboa, Lisbon, Portugal, 13 –15 July.

Cohen, W. M., & Levinthal, D. A. (1989). Innovation and learning: the two faces of R & D. *The economic journal*, *99*(397), 569-596.

Colombo, M. G., Delmastro, M., & Grilli, L. (2004). Entrepreneurs' human capital and the start-up size of new technology-based firms. *International journal of industrial organization*, *22*(8), 1183-1211.

Yazid Abdullahi Abubakar, Jay Mitra & Adeyeye, Mercy Modupe (2018) Mobile telephony and new business formation rates in BRICS and beyond: Does human capital matter? Journal of Entrepreneurship and Innovation in Emerging Economies, 4(2)137-148.

Cosar, A. K. (2011). Human capital, technology adoption and development. *The BE Journal of Macroeconomics*, *11*(1).

CGGC (2011), The Offshore Services Global Value Chain. Center on Globalization, Governance and Competitiveness. Duke University, North Carolina

Deloitte (2007). Global Mobile Tax Review 2006-2007 - Tax regimes that recognise mobile phones as a need not a luxury benefit all stakeholders, Deloitte and GSM Association.

Djiofack-Zebaze, C., & Keck, A. (2009). Telecommunications services in Africa: the impact of WTO commitments and unilateral reform on sector performance and economic growth. *World Development*, *37*(5), 919-940.

Doms, M., Dunne, T., & Troske, K. R. (1997). Workers, wages, and technology. *The Quarterly Journal of Economics*, *112*(1), 253-290.

Eaton, J., & Kortum, S. (1999). International technology diffusion: Theory and measurement. *International Economic Review*, *40*(3), 537-570.

Filatotchev, I., Liu, X., Lu, J., & Wright, M. (2011). Knowledge spillovers through human mobility across national borders: Evidence from Zhongguancun Science Park in China. *Research Policy*, *40*(3), 453-462.

Foster, A. D., & Rosenzweig, M. R. (1995). Learning by doing and learning from others: Human capital and technical change in agriculture. *Journal of political Economy*, *103*(6), 1176-1209.

Fu, X. (2008). Foreign direct investment, absorptive capacity and regional innovation capabilities: evidence from China. *Oxford Development Studies*, *36*(1), 89-110.

Goldman Sachs (2003). Dreaming with BRICs: The Path to 2050. *Global Economics Paper,* 9.

Goldman Sachs (2007),.The N-11: More Than an Acronym. *Global Economics Paper*, 153.

GSMA. (2011). African Mobile Observatory 2011, Driving Economic and Social Development through Mobile Services. GSMA Association

GSMA (2015). The mobile economy: Pacific Islands, GSMA. Online. Available at: https://www.gsmaintelligence.com/research/?file=23485245295f02524925b2bd3aeec6de&download (Accessed: 18th June 2017)

GSMA (2017). Economic Impact: Bangladesh Mobile Industry, GSMA. Online. Available at: https://www.gsma.com/spectrum/wp-content/uploads/2017/01/Economic-Impact-Bangladesh-Mobile-Industry.pdf (18th June, 2017)

Yazid Abdullahi Abubakar, Jay Mitra & Adeyeye, Mercy Modupe (2018) Mobile telephony and new business formation rates in BRICS and beyond: Does human capital matter? Journal of Entrepreneurship and Innovation in Emerging Economies, 4(2)137-148.

Hagerstrand, T. (1967). *Innovation diffusion as a spatial process*. Chicago: University of Chicago Press.

Hellström, J., & Tröften, P. E. (2010). *The innovative use of mobile applications in East Africa*. Swedish international development cooperation agency (Sida).

James, J. (2014). Patterns of mobile phone use in developing countries: evidence from Africa. *Social indicators research*, *119*(2), 687-704.

Kahn, M. J. (2011). The BRICS and South Africa as the gateway to Africa. *Journal of the Southern African Institute of Mining and Metallurgy*, *111*(7), 493-496.

Kathuria, R., Uppal, M., & Mamta. (2009). India: The impact of mobile phones, moving the debate forward. *Vodafone Policy Paper Series*, *9*.

Keeble, D., & Wilkinson, F. (1999). Collective learning and knowledge development in the evolution of regional clusters of high technology SMEs in Europe. *Regional studies*, *33*(4), 295-303.

Kesidou, E., & Romijn, H. (2008). Do local knowledge spillovers matter for development? An empirical study of Uruguay's software cluster. *World development*, *36*(10), 2004-2028.

Kesidou, E., & Szirmai, A. (2008). Local knowledge spillovers, innovation and economic performance in developing countries: a discussion of alternative specifications.

Klapper, L., & Richmond, C. (2009). Patterns of business creation, survival, and growth: evidence from a developing country. *Development Research Group, World Bank, Washington, DC*.

Nolen, P. (2008). Does ICT Benefit the Poor? Evidence from South Africa.

Kuriyan, R., Ray, I., & Toyama, K. (2008). Information and communication technologies for development: The bottom of the pyramid model in practice. *The Information Society*, *24*(2), 93-104.

Kuriyan, R., Ray, I., & Toyama, K. (2008). Information and communication technologies for development: The bottom of the pyramid model in practice. *The Information Society*, *24*(2), 93-104.

Mambula, C. (2002). Perceptions of SME growth constraints in Nigeria. *Journal of Small Business Management*, *40*(1), 58.

Yazid Abdullahi Abubakar, Jay Mitra & Adeyeye, Mercy Modupe (2018) Mobile telephony and new business formation rates in BRICS and beyond: Does human capital matter? Journal of Entrepreneurship and Innovation in Emerging Economies, 4(2)137-148.

Marshall, A. (1890). *Principles of economics: An introductory volume* (Eighth Edition., p. 871). London: Macmillan.

Maskell, P., & Malmberg, A. (1999). Localised learning and industrial competitiveness. *Cambridge journal of economics*, 167-185.

Mitra, J., Abubakar, Y. A., & Sagagi, M. (2011). Knowledge creation and human capital for development: the role of graduate entrepreneurship. *Education+ training*, *53*(5), 462-479.

Muto, M., & Yamano, T. (2009). The impact of mobile phone coverage expansion on market participation: Panel data evidence from Uganda. *World development*, *37*(12), 1887-1896.

Nelson, R.R. and Phelps, E.S. (1966). Investment in Humans, Technological Diffusion, and Economic Growth, *The American Economic Review*, 56, 69-75.

Nyamba, S. Y., & Mlozi, M. R. (2012). Factors influencing the use of mobile phones in communicating agricultural information: A case of Kilolo District, Iringa, Tanzania. *International Journal of Information and Communication Technology Research*, *2*(7).

OECD (2012). StatExtracts, Organization for Economic Co-operation and Development (OECD). Online. Available at: http://stats.oecd.org/Index.aspx?themetreeid=-200 (Accessed: 5th October, 2012)

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior research methods*, *36*(4), 717-731.

Pred, A. R. (1966). *The spatial dynamics of US urban-industrial growth, 1800-1914: interpretive and theoretical essays*. MIT press.

Price Waterhouse Coopers (2011). Indian Mobile Services Sector - Struggling to maintain sustainable growth. Cellular Operators Association of India.

Pyramid Research (2010) The Impact of Mobile Services in Nigeria: How Mobile Technologies are Transforming Economic and Social Activities. Pyramid Research.

Qiang, C. Z. (2009). Mobile Telephony: A Transformational Tool for Growth and Development. *Proparcos Magazine*.

Qian, H., Acs, Z. J., & Stough, R. R. (2012). Regional systems of entrepreneurship: the nexus of human capital, knowledge and new firm formation. *Journal of Economic Geography*, lbs009.

Roger, F. (2009). How to Succeed in Developing Countries for a Mobile Telephony Operator? The Case of Milicom. *Proparco's Magazine*, November 2009.

Yazid Abdullahi Abubakar, Jay Mitra & Adeyeye, Mercy Modupe (2018) Mobile telephony and new business formation rates in BRICS and beyond: Does human capital matter? Journal of Entrepreneurship and Innovation in Emerging Economies, 4(2)137-148.

Saxenian, A. (1994). *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*. Cambridge, MA: Harvard University Press.

Saxenian, A. (2002). Transnational communities and the evolution of global production networks: the cases of Taiwan, China and India. *Industry and Innovation*, *9*(3), 183-202.

Saxenian, A. (2005). From brain drain to brain circulation: Transnational communities and regional upgrading in India and China. *Studies in Comparative International Development (SCID)*, *40*(2), 35-61.

Schneider, M. F., & Enste, D. (2000). *Shadow economies around the world: Size, causes, and consequences* (No. 0-26). International Monetary Fund.

Sey, A. (2008). Where did all the Payphones go? Intermediaries, Innovation and Insecurity in the Mobile Phone Industry', Paper presented at the International Communication Association Pre-Conference on Mobile Communication. 'The Global and Globalizing Dimensions of Mobile Communication: Developing or Developed?' Montreal, Canada.

Shu, C., Liu, C., Gao, S., & Shanley, M. (2014). The knowledge spillover theory of entrepreneurship in alliances. *Entrepreneurship Theory and Practice*, *38*(4), 913-940.

Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. *Sociological methodology*, *13*, 290-312.

Sridhar, K.S. and Sridhar, V. (2007). Telecommunications Infrastructure and Economic Growth: Evidence from Developing Countries. *Applied Econometrics and International Development*, 7(2).

Stanley, R. (2005). Village Phone–A tool for empowerment. *Grameen Foundation, USA Publication Series*.

Stuart, T., & Sorenson, O. (2003). The geography of opportunity: spatial heterogeneity in founding rates and the performance of biotechnology firms. *Research policy*, *32*(2), 229-253.

Suliman, Abubakr MT. "Is it really a mediating construct? The mediating role of organizational commitment in work climate-performance relationship." *Journal of Management Development* 21.3 (2002): 170-183.

Tavassoli, S., Bengtsson, L., & Karlsson, C. (2017). Strategic entrepreneurship and knowledge spillovers: spatial and aspatial perspectives. *International Entrepreneurship and Management Journal*, *13*(1), 233-249.
.

Fredriksson, T., Barayre, C., Gil, S. F., Korka, D., Lang, R., Nigmatov, A., ... & Miroux, A. (2010). *Information economy report 2010: ICTs, enterprises and poverty alleviation*. UN.

Yazid Abdullahi Abubakar, Jay Mitra & Adeyeye, Mercy Modupe (2018) Mobile telephony and new business formation rates in BRICS and beyond: Does human capital matter? Journal of Entrepreneurship and Innovation in Emerging Economies, 4(2)137-148.

UNCTAD, (2008). The Creative Economy Report 2008: The challenge of assessing the creative economy towards informed policy-making. United Nations, New York.

UNCTAD. (2011). Least developed countries 2011 - The Potential Role of South-South Cooperation for Inclusive and Sustainable Development. UNCTAD.

UNDP. (2010). Human Development Report 2010 - The Real Ialth of Nations: Pathways to Human Development (20th Anniversary Edition ed.). United Nations Development Programme (UNDP), New York.

UNDP. (2012). Human Development Index. Online. Available at: http://hdr.undp.org/en/statistics/hdi/ (Accessed: 5th October 2012)

Utterback, J. M. (1974). Innovation in industry and the diffusion of technology. *Science*, *183*(4125), 620-626.

Venkataraman, S. (1997). The distinctive domain of entrepreneurship research. *Advances in entrepreneurship, firm emergence and growth*, *3*(1), 119-138.

Verheul, I., Wennekers, S., Audretsch, D., & Thurik, R. (2002). An eclectic theory of entrepreneurship: policies, institutions and culture. In *Entrepreneurship: Determinants and policy in a European-US comparison* (pp. 11-81). Springer US.

Gough, N., & Grezo, C. (2005). Africa: The impact of mobile phones. *Berkshire, England: Vodafone Policy Paper Series*, *2*.

Wahba, J., & Zenou, Y. (2012). Out of sight, out of mind: Migration, entrepreneurship and social capital. *Regional Science and Urban Economics*, *42*(5), 890-903.

Wamae, W. (2009). Enhancing the role of knowledge and innovation for development. *International Journal of Technology Management & Sustainable Development*, *8*(3), 199-220.

Waverman, L., Meschi, M., and Fuss, M. (2005). The Impact of Telecoms on Economic Growth in Developing Countries. In V. P. P. S. (ed) (Ed.), *Africa: The Impact of Mobile Phones, Vodafone Group*, Vol 2, pp 10-23.

WDI. (2012),World Development Indicators. World Bank, Online. Available at: http://data.worldbank.org/indicator (Accessed: 5th October, 2012)

West, M. and Chew, H.G (2014). Reading in the mobile era: A study of mobile reading in developing countries. Policies issues series.

Wong, P. K., Ho, Y. P., & Autio, E. (2005). Entrepreneurship, innovation and economic growth: Evidence from GEM data. *Small business economics*, *24*(3), 335-350.

Yazid Abdullahi Abubakar, Jay Mitra & Adeyeye, Mercy Modupe (2018) Mobile telephony and new business formation rates in BRICS and beyond: Does human capital matter? Journal of Entrepreneurship and Innovation in Emerging Economies, 4(2)137-148.

World Bank (2008). *Technology Diffusion in the Developing World*, Global Economic Prospects. World Bank, Washington.

World Bank (2011). Sub-Saharan Africa', *Global Economic Prospects: Regional Annex.* World Bank.

World Bank (2012). Country and Lending Groups. World Bank. Online. Available at: http://data.worldbank.org/about/country-classifications/country-and-lending-groups (Accessed: 7th October, 2012)

World Resources Institute (2007). The Next 4 Billion - Market size and business strategy at the base of the pyramid. *The International Finance Institute.*

Xu, B. (2000). Multinational enterprises, technology diffusion, and host country productivity growth. *Journal of development economics*, *62*(2), 477-493.

Yang, D. (2005). International Migration, Human Capital, and Entrepreneurship: Evidence from Philippine Migrants' Exchange Rate Shocks. *World Bank Policy Research Working Paper*, World Bank, Washinton, DC.

Yang, H., & Steensma, H. K. (2014). When do firms rely on their knowledge spillover recipients for guidance in exploring unfamiliar knowledge?. *Research policy*, *43*(9), 1496-1507.

Zhu, W., Chew, I. K., & Spangler, W. D. (2005). CEO transformational leadership and organizational outcomes: The mediating role of human–capital-enhancing human resource management. *The Leadership Quarterly*, *16*(1), 39-52.

Zucker, L. G., Darby, M. R., & Brewer, M. B. (1994). *Intellectual capital and the birth of US biotechnology enterprises* (No. w4653). National Bureau of Economic Research.

Notes:

[i] Although South Africa's population is much smaller than the other four, it is nevertheless part of BRICs because of its economic leadership in Africa (Kahn, 2011).

[ii] Based on a 3 year average estimate of the GNI per capita, with a threshold of $905 for possible cases of addition to the list, and a maximum of $1,086 for graduation from LDC status

[iii] Involving a composite index known as the Human Assets Index, based on indicators of nutrition, health, school enrolment and literacy; and

[iv]Made-up of a composite index known as the Economic Vulnerability Index, based on indicators of natural shocks, trade shocks, exposure to shocks, economic smallness; and economic remoteness

[v] **All Developing Countries (Inc. BRICs):** Albania, Algeria, Argentina, Armenia, Azerbaijan, Belarus, Belize, Bhutan, Bolivia, Bosnia and Herzegovina, ***Brazil***[a], Bulgaria, Burkina Faso, Cambodia, Colombia, Costa Rica, Dominica, Dominican Republic, El Salvador, Ethiopia, Gabon, Georgia, Guatemala, ***India***[a], Indonesia, Jamaica, Jordan, Kazakhstan, Kosovo, Kyrgyz Republic, Latvia, Lithuania, Macedonia, FYR Madagascar, Malawi, Malaysia,

Maldives, Mauritius, Mexico, Moldova, Montenegro, Morocco, Niger, Nigeria, Pakistan, Panama, Peru, Philippines, Romania, ***Russian Federation[a]***, Rwanda, Senegal, Serbia, ***South Africa[a]***, Sri Lanka, Suriname, Tajikistan, Thailand, Tunisia, Turkey, Uganda, Ukraine, Uruguay, Uzbekistan, Vanuatu and Zambia. **(a)** Member of BRICs countries. Note howver that WDI (2012) has no data on New Business registration for China, so China is not included in the sample.

[vi] **Non-BRICs Developing Countries:** Albania, Algeria, Argentina, Armenia, Azerbaijan, Belarus, Belize, Bhutan, Bolivia, Bosnia and Herzegovina, Bulgaria, Burkina Faso, Cambodia, Colombia, Costa Rica, Dominica, Dominican Republic, El Salvador, Ethiopia, Gabon, Georgia, Guatemala, Indonesia, Jamaica, Jordan, Kazakhstan, Kosovo, Kyrgyz Republic, Latvia, Lithuania, Macedonia, FYR Madagascar, Malawi, Malaysia, Maldives, Mauritius, Mexico, Moldova, Montenegro, Morocco, Niger, Nigeria, Pakistan, Panama, Peru, Philippines, Romania**,** Rwanda, Senegal, Serbia**,** Sri Lanka, Suriname, Tajikistan, Thailand, Tunisia, Turkey, Uganda, Ukraine, Uruguay, Uzbekistan, Vanuatu and Zambia.

[vii] **LDCs:** Bhutan, Burkina Faso, Cambodia, Ethiopia, Madagascar, Malawi, Maldives, Niger, Rwanda, Senegal, Uganda, Vanuatu and Zambia.

[viii] Baron and Kenney's (1986) test of mediation involves establishing four conditions: 1) ***Step One:*** *The Independent Variable* (that is Mobile Phone Diffusion) is significantly related to the *Dependent Variable* (that is New Business Formation Rates); 2) ***Step Two:*** The *Independent Variable* (that is Mobile Phone Diffusion) is significantly related to the *Mediator Variable* (Education Level); ***Step Three:*** The *Mediator Variable* (Education Level) is significantly related to *the Dependent Variable* (that is New Business Formation Rates); ***Step Four:*** When controlling for the effects of the *Mediator Variable* (Education Level) on *Dependent Variable* (that is New Business Formation Rates), the effect of the *Independent Variable* (that is mobile phone diffusion) on the *Dependent Variable* (that is New Business Formation Rates) is no longer significant. Baron and Kenney's procedure is a common approach used to test mediators (Berger, Cunningham and Kozinets, 1999; Suliman, 2002; Preacher and Hayes, 2004; Zhu, Chew and Spranger, 2005). The regressions are based on ordinary least squares (OLS). Hierarchical regressions ire also in testing the Steps 3 and 4 of Baron and Kenney's procedure.

[ix] **Sobel test and the indirect effects:** The Sobel Test (Sobel, 1982) can be used to test whether the indirect effect of the *Mobile Phone diffusion* on the *New business formation rates* through the *Education Level* is significantly greater than zero. The Sobel test entails the use of unstandardised regression coefficients for the effects of the independent variable (Mobile phone diffusion) on the Mediator Variable (Education Level) and the Mediator Variable (Education Level) on the Dependent Variable (New business formation rates) and their standard errors. The unstandardised coefficients and their standard errors for the relationship between *Mobile phone diffusion* and *Education Level* for ALL DEVELOPING COUNTRIES (INCLUDING BRICs) are: (unst. coefs: 001; Std. Error: 000); NON-BRICs DEVELOPING COUNTRIES (unst. coefs: 001; Std. Error: 000); LDCs (unst. coefs: 002; Std. Error: 001). The unstandardised coefficients and their standard errors the relationship between Education Level and New business formation rates) are: ALL DEVELOPING COUNTRIES (INCLUDING BRICs) (unst. coefs: 3.750; Std. Error: 1.165); NON-BRICs DEVELOPING COUNTRIES (unst. coefs: 3.838; Std. Error: 1.211); LDCs (unst. coefs: 2.962; Std. Error: 1.112). A Sobel test performed for ALL DEVELOPING COUNTRIES (INCLUDING BRICs) shows that the indirect effect of *Mobile phone diffusion* on *New business formation rates* through *Education Level* is significant (p <0.001). For NON-BRICs DEVELOPING COUNTRIES, the indirect effect of *Mobile phone diffusion* on *New business formation rates* through *Education Level* is significant (p <0.001). In contrast, for LDCs the indirect effect of *Mobile phone diffusion* on *New business formation rates* through *Education Level* is not significant (p <0.1).

[x] This is because ***working age population*** is preferred to population or employment as a size indicator, because it is a better measure of the number of potential entrepreneurs (Acs and Armington, 2004: p.250). This labour market approach has a particular appeal in that the entrepreneur starting a new business is assumed to live in the same geographic area as the new business and to have benefited from spillovers within that geographic area (Acs and Armington, 2004). Using controls for working age population is particularly important especially when BRICs are considered in the sample, because large workforce is considered as one of the key determinants of the economic performance of BRICs (Goldman Sachs, 2003).

[xi] A control variable for ***Migrant Returnees from Developed Countries*** was also included into the analysis, since returning migrants from developed countries may also contribute to entrepreneurship in developing countries (Saxenian, 2005). This again is particularly important because some studies in some BRICs countries and some emerging countries have shown that migrants are very important contributors to entrepreneurial

experimentation and upgrading in their home countries (Saxenian, 2005; Yang, 2005; Wahba and Zenou, 2012). The data for *Migrant Returnees from Developed Countries* was obtained from OECD StatExtracts - 2005-2009, data on outflows of foreign population from OECD countries (OECD, 2012)

[xii] Controls are also included for ***University Research***, because the Knowledge Spillover Theory argues that it is an important input in the entrepreneurship process as it generates the new knowledge needed for new businesses formation (Audretsch, Lehmann and Warning, 2005). *University Research* is measured using data on number of scientific and technical journal articles published, which was obtained from *World Development Indicators* 2005-2009 (WDI, 2012).

[xiii]Control for ***Population Growth*** was added because a growing population often increases the supply of potential founders of new businesses, or even growth in existing businesses (Acs and Armington, 2004). This is especially important because some LDCs are included in the sample, and economic performance in LDCs may be affected by population growth (UNCTAD, 2011: p.3). The data was obtained from *World Development Indicators* 2005-2009 (WDI, 2012).

[xiv] Control was applied for varying rates of ***Economic Growth*** across the developing countries, as research suggests that economic growth as measured by GDP growth may influence entrepreneurship (Wong, Ho and Autio, 2005). Economic growth was measured using GDP growth, as reported in data from *World Development Indicators* 2005-2009 (WDI, 2012)

[xv] Further, controls are also applied for ***Foreign Direct Investment (FDI)***, because research suggests that FDI influences entrepreneurship in some developing countries like China (Fu, 2008). FDI was measured using data on FDI, net inflows from *World Development Indicators* 2005-2009 (WDI, 2012).