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Network Structure and Innovative Performance of African Entrepreneurs: The Case of Uganda†

Gerrit Rooks[a,b,*], Adam Szirmai[c] and Arthur Sserwanga[b]

[a]Eindhoven University of Technology, Den Dolech 2, Eindhoven, The Netherlands
[b]Makerere University Business School, Plot 118, Old Port Bell Road, PO Box 1337, Kampala, Uganda
[c]UNU-MERIT, Keizer Karelplein 19, 6211 TC, Maastricht, The Netherlands

* Corresponding author: Gerrit Rooks. Telephone: +31 40 2475509. E-mail: g.rooks@tue.nl

Abstract

In this study, we examine the impact of social capital on entrepreneurial innovativeness in an African context. Social capital refers to resources that are embedded in a durable network of relationships. This article focuses specifically on the structure of networks. There are two main views on the relation between network structure and entrepreneurial performance. One view argues that closed networks are beneficial for cooperation and resource sharing, which is needed to implement an innovation, while another view argues that closed networks constrain entrepreneurs, since it is open networks that provide entrepreneurs with fresh information and ideas. Based on these arguments, we hypothesise that the relationship between the degree of constraint of a network and innovative performance has an inverted U-shape. We also examine the hypothesis that overlap between personal and business networks will hamper innovative performance of entrepreneurs because information will be less diverse and heterogeneous, and

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because re-distributive kinship obligations may act as a drain on entrepreneurial resources. We test our hypotheses using a recent survey of about 700 Ugandan rural and urban entrepreneurs. Our hypotheses are supported in the urban sample, but not in the rural sample.

JEL classification: L26, C21, L14, O31

1. Introduction

This paper analyses the structure of the networks of small entrepreneurs and the impacts of network structure on innovative performance in a developing country context. Networks are seen as a potential source of social capital, which may contribute to the innovative performance of the entrepreneurs. But this depends on the characteristics of the networks. Some network structures create obstacles to innovative performance, rather than contributing to it.

In the last two decades, there has been a surge of interest in the concept of social capital.[1] Bourdieu was one of the first authors to give a systematic account of social capital. He defined it as 'the aggregate of the actual or potential resources which are linked to the possession of a durable network of more or less institutionalised relationships of mutual acquaintance or recognition' (Bourdieu, 1985, p. 248). As Portes (1998) notes, this definition makes clear that social capital consists of two elements: first the network of the relationships which allows individuals to access resources possessed by their associates, and second the quantity and quality of resources possessed by members of a network. Our view of social capital is best reflected in the definition of Nahapiet and Ghoshal (1998, p. 243): 'the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit.' From this definition of social capital, it is clear that networks and social capital are closely related.[2]

[1] See Akçomak and ter Weel (2009); Anderson and Miller (2003); Arenius and De Clercq (2005); Baum *et al.* (2000); Bosma *et al.* (2004); Brüderl and Preisendörfer (1998); Coleman (1988); Davidson and Honig (2003); Greve (1995); Hoang and Antoncic (2003); Knack and Keefer (1997); Nahapiet and Ghoshal (1998); Pennings *et al.* (1998); Raub *et al.* (2007); Rooks *et al.* (2011); Stuart *et al.* (1999).

[2] There are various other definitions of social capital, which focus on macro-characteristics of a society and are not directly linked to networks (for instance, Putnam, 1995). In this paper, we explicitly choose for a network-related concept of social capital. This concept is closest to the economic concept of capital. Actors can invest time and resources in physical capital accumulation or education. They can also invest in social relationships.

Notwithstanding the expanding literature on social capital, many questions about the relationships between social capital and entrepreneurship still remain to be answered. One of those open questions concerns the relation between social capital and entrepreneurial innovation in developing countries (Szirmai *et al.*, 2011). This article attempts to address this gap.

In this article, we focus specifically on the relation between the *structure* of a social network and entrepreneurial innovation. The actors with whom an entrepreneur has relationships may have various relationships among themselves as well. In one main theory of social capital, it is argued that connections among the contacts of an entrepreneur are beneficial, since they help produce a trustworthy environment (Coleman, 1988). In another main theory, it is argued that relationships among contacts of an entrepreneur are not beneficial but act as *constraints* (Burt, 1992). In this view, entrepreneurs should not invest time and effort in contacts that are already connected to other contacts of the entrepreneur. It is better to connect to people outside the own network, so that the entrepreneur has access to heterogeneous sources of information. In this article, we study the relation between the degree to which a network constraints an entrepreneur, i.e., the amount of redundant ties, and innovativeness of that entrepreneur.

We use data from a recent survey among Ugandan entrepreneurs held in May 2008. Uganda is an interesting case for the study of entrepreneurship. It has a Total Entrepreneurial Average index of 30% of the working population (Walter *et al.*, 2004). Some 3.1 million people are estimated to be entrepreneurs, of which 65% are males (Walter *et al.*, 2003, 2004). At first sight, this makes Uganda one of the most entrepreneurial countries in the world. But on closer inspection, such indicators are misleading if the developing country context is not taken into account. Rooks *et al.* (2010) found that the great majority of Ugandan enterprises in the sample were micro-enterprises which showed little or no dynamism and growth. Of the total sample of 737 entrepreneurs, only a subset of twenty-five to forty entrepreneurs qualified as dynamic Schumpeterian entrepreneurs. The rest were primarily survival entrepreneurs, who operated their own businesses simply because there were no other options available. The kinds of innovation that small entrepreneurs engage in are very minor incremental innovations, which are new only to the firm, not to the domestic market, let alone new to the world. The business failure rate is reportedly very high. On average, 30% of the entrepreneurs shut down their businesses within the first 12 months of operation.

2. Network constraint and innovative performance

There are two more or less opposing views on the relation between network structure and social capital. One perspective associated with the name of Coleman (1991) argues that social capital is created if the relations of an actor know each other. The other perspective associated with the name of Burt (1992) argues that social capital is created if the relations of an actor do not know each other.

Let us first consider the perspective that argues that it is better to have networks where relations know each other. Suppose that a network consists of three actors A, B and C who are all related to each other (Figure 1B). Since all actors are connected to each other, the network is 'closed'. One important characteristic of closed networks is that they allow for the application of informal social sanctions. Informal sanctions may be used to punish uncooperative behaviour, and thus encourage cooperative behaviour. Suppose that actor A carries out an action that imposes negative externalities on actor B, say for instance A cheats in a transaction. In a closed network, informal social sanctions such as gossip can then be applied (Macaulay, 1963; Coleman 1991, p. 11; Rooks *et al.*, 2011). Actor B can tell actor C about the incident, which may be harmful for actor A since actor C can then decide, for instance, not to transact with actor A anymore. Assuming that actor A is far-sighted, A will know this beforehand, and cheating will be deterred. In this way, a norm against cheating emerges. This development of norms facilitates cooperation and the sharing of resources (Marwell *et al.*, 1998; Dyer and Nobeoka, 2000).

Compare this network to the network depicted in Figure 1A. Since B and C are not connected to each other but to other actors (D and E), this is an 'open' network. In the second perspective associated with Burt (1992, 1997, 2000), it is argued that such open network structures are better at creating

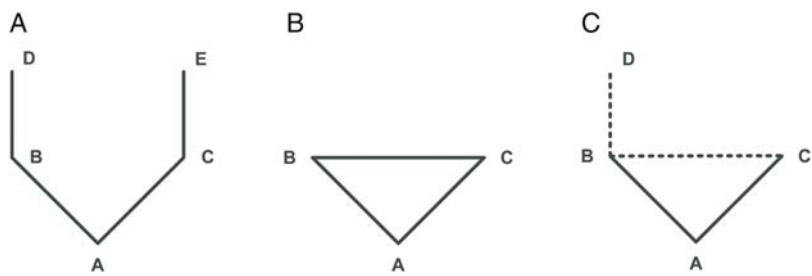

Figure 1: A Network without (A) and with (B) Closure, and an Illustration of Network Formation (C). Source: Adapted from Coleman (1988) with permission © 1988 by The University of Chicago

social capital. Burt argues that if A is connected to B, then there is no real need to connect to C as well (as in Figure 1B). For actor A, it is better to have relationships with persons B and C, who are unconnected with each other (as in Figure 1A). There are two reasons for this. First, actor A has an information benefit. Assuming that information travels slowly, and is imperfectly transmitted, actor A will receive more heterogeneous information from multiple sources.[3] Second, actor A also has brokerage possibilities because actor A is in between the two unconnected actors B and C. If we apply this reasoning to Figure 1B, actor A does not 'need' the relation with actor C. This is because actor A can get the same information from actor B. Moreover, there are no brokerage possibilities because B and C are connected. Since actor A does not need the relation with actor C in Figure 1B, this relation is also called a 'redundant' tie, which 'constrains' actor A.

To further illustrate the concept of redundancy, consider Figure 1C. Suppose that actor B is searching for a new relationship, and suppose that there are two new possible relationships, one with A and one with B. Because of time constraints, actor B has to choose for one of the two relationships. According to Burt's perspective, B would be better off in choosing D, since he is already indirectly connected to C. A relationship with C would not yield much new information.[4]

Burt (1992, p. 54) introduced the concept of constraint to operationalise the idea of redundant ties. The idea of constraint is illustrated in Figure 2. Contact j constrains the opportunities of an entrepreneur if that entrepreneur invests relatively much time and energy in that contact (p_{ij}), and if that contact j is strongly connected with other contacts q of the entrepreneur (m_{qj}).

Burt (1992) proposed the following formula to define the degree to which entrepreneur i is constrained by his or her contact with j:

$$c_{ij} = (p_{ij} + \sum_{q} p_{iq} m_{qj})^2, \quad \text{for } q \neq i, j. \tag{1}$$

According to this formula, the degree to which entrepreneur i is constrained by contact j (c_{ij}) is determined by two elements: the amount of

[3] Note, however, that in connected networks where information exchange is immediate and perfect, A has no information advantage (Bala and Goyal, 1998). The information advantage of A in an open network depends on the assumption that information flows are imperfect.

[4] Figure 1C focuses on the choice of actor A. A similar choice has to be made by actor C.

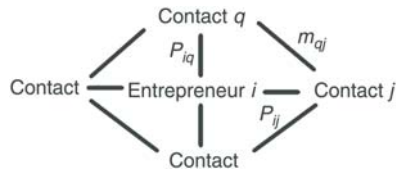

Figure 2: An Illustration of an Ego Network of an Entrepreneur. Source: Authors' own illustration.

time and energy invested in contact j (p_{ij}), and the degree to which contact j is connected to other contacts q of the entrepreneur ($\sum_q p_{iq}m_{qj}$). The concept constraint can thus be understood as a measure that indicates the extent to which entrepreneur i is wasting his time in cultivating a redundant contact j. The higher the constraint, the more time and energy the entrepreneur is investing in a contact j that is investing relatively much time and energy in common contacts q, with which i already has a direct relationship.[5] The degree to which the network as a whole constrains actor A equals the sum of all the constraints that A is subject to, through his relationships with other actors j in the network.

Applied to innovative performance, the literature suggests two potential conflicting hypotheses. The first hypothesis derives from the Coleman tradition and argues that increasing constraint is positively associated with innovative performance. The second tradition derives from the Burt tradition and argues that innovative performance is likely to be negatively associated with constraints. Combining insights from these two perspectives, we hypothesise that the relationship between constraint and innovative performance will have an inverted U-shape. Increasing constraint will initially increase innovative performance, but this increase will slow down and after reaching an optimum, increasing constraint will increasingly reduce innovative performance.

A low level of constraint implies that an entrepreneur has only few redundant contacts; this situation reflects Figure 1A. On the one hand, this is advantageous, since the entrepreneur is provided with more and better information from heterogeneous sources. Having access to heterogeneous sources of information is especially important for innovative

[5] To illustrate the constraint measure with a numerical example, assume for simplicity that all p's and m's are either 0 or 1. In the open network (Figure 1A), the degree to which actor A is constrained by B is $(p_{ab} + p_{ac}m_{bc})^2 = (1 + 1 * 0)^2 = 1$. In the closed network (Figure 1B), the degree to which actor A is constrained by B is $(p_{ab} + p_{ac}m_{bc})^2 = (1 + 1 * 1)^2 = 4$.

performance (Rogers, 2003). Better connected entrepreneurs will, for instance, be able to speedily react to new market circumstances, and have better, more creative ideas (Burt, 2004). However, lower levels of constraint also create complications. Obstfeld (2005) argues that low levels of constraint are associated with action problems: 'Structural holes pose an action problem because the dispersed, unconnected people found around structural holes are inherently more difficult to mobilise or coordinate, especially around novel ideas' (p. 101). Implementing novel ideas is often a cooperative effort (Shane *et al.*, 1994). Hence, at very low levels of constraint, entrepreneurs will have access to more heterogeneous sources of information, and as a consequence have better, more innovative ideas. However, implementing those novel ideas, which is often a cooperative effort, will be difficult because of action problems. On balance, we expect positive effects of increasing constraints on performance to outweigh the negative effects at lower levels of constraint.

The other situation is a network where constraint is very high. A simple version of such a closed network with many redundant ties is depicted in Figure 1B. In a network with high constraint, implementing novel ideas, which is often a cooperative effort, will be relatively easy. But, while cooperation is easier, entrepreneurs in highly constrained networks will have less access to heterogeneous sources of information. As a result of the lack of fresh information, they will be less creative, and have less innovative ideas than entrepreneurs with lower degrees of constraint (Granovetter, 1973; Burt, 1997; Obstfeld, 2005). At very high levels of constraint, networks even tend to become inward looking, and lose connection with the external world (Uzzi, 1997). As a consequence, at high levels of constraint, entrepreneurs may not have access to ideas, novelties and innovations originating outside the network. Another negative aspect of extremely constrained networks involves aspects of dependency and loss of autonomy. For example, tight social networks can prevent immigrants from breaking away into new markets (Portes, 1998). On balance therefore, at higher levels of constraint, increasing constraint will be associated with lower levels of innovative performance.

Entrepreneurs who have networks with intermediate degrees of constraint combine both types of benefits. On the one hand, they tap into heterogeneous sources of novel information much needed for innovation, while at the same time there is sufficient closure and bonding to avoid action problems (Burt, 2001). Hence, given the discussion above, we argue that the relation between network constraint and innovation performance will be non-linear.

Hypothesis 1 At lower levels of constraint, increases in constraint are associated with increases in innovative performance. Beyond some optimum, increases in constraint are associated with decreases in innovative performance.

3. Network overlap and innovative performance

Network overlap is the degree to which the members of a network have multiple types of relations with each other: family and personal relations, financial relations, political relations, business relations and so forth. Hence, the concept network overlap is about the degree to which network relationships are multi-dimensional (Ibarra, 1995). In other words, network overlap is about different types of network being concentrated in one person (Granovetter, 1973). This implies that different types of resources flow through one and the same contact (Podolny and Baron, 1997).

In the interlocking markets literature in development economics, it has often been argued that family and kinship relations play a pivotal role in many African micro-enterprises. Relatives are often business advisers, sources of finance, employees or employers. The evidence on the role of family and kinship ties is mixed. On the one hand, it is argued that kinship ties can be mobilised for capital accumulation, as is the case for Chinese entrepreneurs in East Asia (e.g., Perkins, 2000). On the other hand, the redistributive obligations within kinship networks in African and Middle Eastern countries are seen as acting as a drain on entrepreneurial resources and as an obstacle for entrepreneurial dynamism (see early anthropological contributions such as Dorjahn, 1962; Hunter, 1962; Khalaf and Shwayri, 1966).

Building on the previous theoretical discussion about benefits and drawbacks of social capital, we identify the following possible impacts of network overlap. (1) If kin and information networks coincide, access to information will be less diverse and heterogeneous. As in the case of closed, highly constrained networks, this is expected to have a negative impact on innovative performance. (2) If kinship and business networks overlap too much, redistributive kinship obligations are expected to act as a drain on entrepreneurial resources and an obstacle to entrepreneurial dynamism and innovation. This effect has been documented in anthropological studies of African and Middle Eastern entrepreneurship cited above. Thus, network overlap should have a negative impact on innovative

performance. (3) On the other hand, Uzzi (1997) argues that network overlap allows for better and more 'fine grained information transfer'. This reasoning reflects the network closure social capital arguments which focus on trust, and shared values in closed networks. In contrast to the previous arguments, this line of reasoning suggests that entrepreneurs with higher degrees of network overlap will be more innovative rather than less. We formulate the hypothesis in negative terms, giving greater weight to the arguments 1 and 2 above.

Hypothesis 2 The larger the overlap between the personal and business networks of an entrepreneur, the less innovative the entrepreneur will be.

4. Data and operationalisations

4.1 Data collection and sample

To test our hypotheses, we make use of a recent survey among Ugandan entrepreneurs held in May 2008. There are no adequate sampling frames of entrepreneurs available in Uganda. We therefore employed a sampling procedure based on the Global Entrepreneurship Survey approach for selecting respondents (see Walter *et al*., 2003, 2004 for more details on the GEM in Uganda). For budgetary reasons, the sample area was restricted to two districts in central Uganda: Kampala, which is the capital city and the leading commercial town of Uganda, and one rural area, namely the Mpigi district.

The sample was selected in a number of steps. First, in each district, three parishes were randomly selected. In the next step, local officials provided us with lists of households, indicating in which households one (or more) of the member was an entrepreneur. From these lists, 750 entrepreneurial households were selected. The selection of households and, subsequently, the respondents within the households was done randomly. If there were more than one entrepreneur within one household, the adult entrepreneurial family members were numbered according to their age, assigning number 1 to the oldest and the highest number to the youngest household member. The respondent was selected according to a random number chosen from a random number table: the second oldest person was selected if the random number chosen was a 2, the fifth oldest if the random number was a 5 etc.

Since in Uganda questionnaires cannot be mailed, faxed or couriered to respondents, the data had to be gathered via face-to-face interviews. The

interviews were carried out by a team of ten interviewers. All but one interviewer had extensive previous experience as an interviewer working for the Global Entrepreneurship Monitor projects of 2003 and or 2004. During the training, sampling procedures, translations of key terms in the questionnaires and handling of respondents were stressed. The interviewers were finally field-tested to assess their ability to handle the data collection, before they embarked on the data collection exercise.

The data collection took place in the first two weeks of May 2008. The response was extremely positive. Small business owners were eager to share their experiences with our interviewers. In almost all cases, the selected respondent was willing to participate in the study. In Kampala, there were five refusals; in Mpigi, two persons refused to participate. Hence, we reached an unusually high response percentage of about 99%. Each interview continued until the informant had completely described the above issues. On average, an interview took 45–60 min.

In total, the sample consists of 993 respondents aged 16–64 years, of which 737 were entrepreneurs. Since the goal of this analysis is to explain why some entrepreneurs are more innovative than others, non-entrepreneurs were not included in the statistical analysis. After the interview with a respondent, the interviewer answered six questions about the interview and the respondent. Based on this information, another forty observations were excluded: seventeen observations because the interviewer seriously doubted the reliability of the answers of the respondent, twenty-three observations because the interviewer indicated that the respondents had trouble understanding the questions. This leaves us with a sample of in total 697 entrepreneurs.

4.2 Measures

4.2.1 Dependent variable: innovativeness

To measure innovativeness, we used a set of five dichotomous indicators that measured whether the entrepreneur had introduced or invested in new or improved products or processes (Table 1). These indicators were adapted from the first South African Innovation Survey (Oerlemans *et al.*, 2004; Rooks *et al.* 2005). Innovativeness in the Ugandan context of small enterprises obviously refers to activities new to the firm, rather than new to the market or to the world. We used a non-parametric item response model, the Mokken model (a probabilistic version of the Guttman scale), to investigate the scalability of the items. The analysis

Table 1: Mean, Range and Scalability Coefficient Mokken *H* for Items Measuring Innovativeness

Item	Mean	Range	Mokken *H*
In the last 3 years, have you invested resources to improve your (business) premises?	0.49	0–1	0.54
In the last 3 years, have you invested resources to improve your (business) machineries or tools?	0.46	0–1	0.55
In the last 3 years, has your business introduced products or services that were new or improved 'to the market'?	0.42	0–1	0.60
In the last 3 years, have you improved your products or services?	0.46	0–1	0.47
Do you plan to change your product mix or service mix within the next year?	0.59	0–1	0.58

indicated that the items constitute a strong scale (Mokken $H = 0.54$).[6] In addition to the scale, we will also use the separate items as dependent variables.

In additional qualitative interviews, we asked entrepreneurs in rural and urban regions for examples of their innovations and investments. One rural entrepreneur who produced drums told us that he introduced the 'Jembe' drum. This kind of drum is different from the usual drums because it uses thread made from fish nets unlike the old ones that use cow thread. These drums have the advantage that they are also very marketable with tourists. In addition, the entrepreneur also introduced drums that have stands. Another rural entrepreneur produced stools, and told us that he invested in material to produce stools. He also introduced new stool designs. An urban entrepreneur told us that he was a web-designer, and he saw the need for web-marketing, so he introduced a new (to the market) web-marketing method using social media. Another urban entrepreneur invested in machinery to be able to produce better printing services.

4.2.2 Measurement of network characteristics

To obtain network data, we followed a standard survey method of collecting ego-centred network data (Marsden, 1990). We used name-generators and interpreters to measure different aspects of the network of entrepreneurs. Multiple name-generators are more reliable than single name-

[6] A Mokken *H* between 0.4 and 0.5 is considered to be a medium-strong scale; above 0.5 is considered to be strong (Mokken and Lewis, 1982; Meijer and Baneke, 2004).

generators when it comes to measuring the size and composition of the network (Marin and Hampton, 2007). Two of the three name-generators were intended to measure business contacts, one to measure personal contacts.

In the first name-generator, we asked about personal contacts with the following question: 'From time to time, most people discuss important personal matters with other people. Looking back over the last six months – who are the people with whom you discussed an important personal matter?' The second question was about contacts with which business matters were discussed: 'From time to time, entrepreneurs seek advice on important business matters. Looking back over the last six months – who are the people with whom you discussed an important business matter?' The third question was about business contacts that could provide material support: 'If you were seeking material support for your business from other entrepreneurs. Looking back over the last six months – who are those entrepreneurs?'

For every name-generator question, the respondent was asked to list names. The maximum number of names was five. Limiting the number of alters is a standard way to cope with time constraints in a survey while maintaining measurement precision and minimising measurement bias (Burt, 1984, p. 315). A disadvantage is that, for entrepreneurs with large networks, we underestimate the size of the network.

There were a number of further questions about each person cited on the name-generator (i.e., alter-generator). Important questions referred to the frequency of contacts with each person and a list of possible resources that could be obtained from the cited contact. We also asked questions about the relationships between each of these alters. This information is needed to calculate the constraint measure.

In total, we collected information about 4,279 contacts of the 737 entrepreneurs in the sample; of those contacts, 2,043 contacts were part of the 'personal network', 1,426 were part of the 'business advice' network and 810 contacts were part of the 'material support' network. The personal network consisted mostly of family (38%) and close friends (40%), and the business advice network consisted mostly of family (36%) and close friends (39%). The material support network was composed differently: it consisted mostly of friends (41%), family (33%) and close friends (18%). Note that in our qualitative interviews and pre-test, we found that 'a friend' in Uganda seems to have a slightly different connotation than in Western countries (where more distant contacts are usually referred to as 'acquaintances' rather than friends).

4.2.3 Constraint

The network characteristic variable constraint is measured as follows.[7]

Based on the formula proposed by Burt (1992), which has been discussed in Section 1, we formally define the degree to which entrepreneur i is constrained by his or her contact with j as follows:

$$c_{ij} = (p_{ij} + \sum_{q} p_{iq} m_{qj}), \quad \text{for } q \neq i, j. \tag{2}$$

Equation (2) indicates the extent to which i is spending his time cultivating a redundant contact j.

According to this formula, the degree to which entrepreneur i is constrained by contact j (c_{ij}) is determined by two elements: the amount of time and energy invested in contact j (p_{ij}), and a term that measures the degree to which contact j is connected to other contacts q of the entrepreneur ($\sum_q p_{iq} m_{qj}$).[8]

p_{ij}, the proportion of entrepreneur i's time and energy invested in contact j as a fraction of time invested in all contacts, is defined as follows:

$$p_{ij} = \frac{z_{ij}}{\sum_j z_{ij}}, \tag{3}$$

where z measures time/energy invested in a relationship; p_{iq} is the proportion of i's time and energy invested on contacts other than j; m_{qj} indicates the strength of the relationship between q and j expressed as a ratio relative to the strongest of q's relationships with anyone else in ego's network:

$$m_{qj} = \frac{z_{qj}}{\max(z_{qj})}, \tag{4}$$

where $\max(z_{qj})$ is the strongest of j's relations with anyone in ego's network (which implies that m_{qj} always has a value between 0 and 1).

[7] Constraint is linked to the concepts' structural holes and brokerage. If a network has a low degree of constraint, there will be many holes in the network. This creates opportunities for brokerage for actors which span the structural holes.

[8] For this study, we somewhat modified the constraint measure of Burt. In equation (1), the pair-wise constraint is squared, which implies that more constrained pairs are given more weight. Since we are interested in a non-linear effect of constraint, we have to square the constraint variable in the regression analysis, which complicates the interpretation of results for the constraint measure as depicted in equation (1). To avoid interpretation problems later on, we therefore do not square the pair-wise values. We thank an anonymous reviewer for this suggestion.

To measure p, the proportion of time entrepreneur i spent with a certain alter j (equation (2)), we make use of a question about the time spent with that alter ('How often do you speak with contact? Daily, weekly, or monthly?'). To measure m, relative strength of the relation between contact j and another contact of the entrepreneur, we make use of a question about the strength of the relation between two alters ('Please think about the relationships between the people you just mentioned. For each contact, please indicate whether this is a relationship contact between strangers, people who are close or people who are very close.'[9]).[10]

The network constraint of an entrepreneur's network as a whole equals the sum of all the pairwise constraints c_{ij} in the ego network:

$$c = \sum c_{ij}. \tag{5}$$

4.2.4 Network overlap

Network overlap is the degree to which the members of a network have multiple types of relations with each other. In our study, we are primarily interested in the degree to which business and personal relationships overlap. We constructed a variable *network overlap* that indicates whether business relations (i.e., information relationships and resource relationships) are also personal relationships.[11] *Network overlap* is defined as the number of times that a contact that was mentioned in the information or material resource networks (i.e., the business networks) was said to be a personal relation as well, divided by the total number of business

[9] In the pre-test, it became apparent that the category 'friend' was confusing for the respondents, if there was a relation between alters they were always friends. We therefore decided to use the close and very close categories.

[10] An alternative formula provided by Burt measures the degree to which entrepreneur i is constrained by his contact with j, as $c_{ij} = (p_{ij} + \sum_q p_{iq}p_{qj})^2$, for $q \neq i, j$, where p_{qj} is the proportion of alter q's time and energy invested in contact j, instead of m_{qj}, which represents the relative strength of the relation. We cannot accurately estimate p_{qj} because we have no information about the contacts of the alters external to the entrepreneurs' ego network. Also, our chosen specification is preferable because it correlates very highly with density measures, so that density and constraint form a common dimension (for this correlation, see Burt, 1992).

[11] We focus on the business–personal relation overlap. There are more possible overlaps between networks, for instance between the business advice and the material resource network. However, these overlaps are not our main research interest.

relations. Hence net *work overlap* is 0 if no business relations overlap with personal relations, and 1 if all business relations are also personal relationships:

$$\text{Network overlap} = \frac{N_o}{N_i + N_r}, \tag{6}$$

where N_o is the number of business or information contacts that are also personal relations; N_i is number of information contacts; N_r is the number of material resource contacts.

4.2.5 Control variables

To control for possible confounding effects, we included a number of control variables.

4.2.6 Size of the network

We include network size as a control variable in our analysis. The size of the network is simply the number of unique contacts mentioned by the respondent. Maximum size is fifteen contacts in total; minimum size, no contacts.

4.2.7 Age

In the literature on entrepreneurship, the entrepreneur's age is often included in regressions. Age has been found to be a factor in the probability of establishing a business. As individuals grow older, they are less likely to invest in the activities necessary to start a new enterprise. Age may also affect innovative performance.

4.2.8 Gender

In most countries, gender has been found to be a significant factor in the probability of establishing a business (Renzulli *et al.*, 2000). To control for gender, we included a dummy variable *gender* (female = 1; male = 0).

4.2.9 Rural versus urban region

The dummy variable *rural* indicates the sample region (rural region = 1; urban region = 0).

4.2.10 Economic sector

We constructed three dummies for economic sectors: customer services, agriculture and manufacturing, with the trade and services sector as the reference category.

4.2.11 Bank credit

To control for possible effects of access to credit markets, we use a question in the interview as to whether bank credit was used for the start up of the business.

Table 2 presents the correlations for the variables defined above. Note that there is a high correlation between network constraint and network size. This suggests that larger networks are the more traditional networks where people know each other, and hence constraint is high. Table 3 presents the means and standard deviations for the total sample, and for the total sample subdivided into the rural and urban samples. As can be seen in Table 3, innovative performance is higher in the rural sample. Network constraint is somewhat lower, and networks are smaller in the urban sample. We find more female entrepreneurs in the urban sample. There are more customer-oriented enterprises in the urban sample, and more agricultural and manufacturing enterprises in the rural sample.

5. Results

Studying network effects empirically is challenging (Manski, 1993; Aral *et al.*, 2009). One important issue is that of endogeneity. In networks, innovation decisions of the entrepreneur may influence the behaviour of other members of the network. Networks are, at least partly, the result of (bilateral) choices that people make (Gulati and Gargiulo, 1999; Fafchamps and Gubert, 2007), so that innovation performance could influence network characteristics. To test whether the endogeneity of constraint was a statistical problem, we performed a Hausman test (Hausman, 1978). As our instrumental variables, we used two variables that do not correlate with innovativeness, while they do correlate with constraint, namely married or not and the proportion of kin in the network. The Hausman test yielded a non-significant result ($\chi^2(10) = 4.24$, $p = 0.936$). According to this result, the null hypothesis of no endogeneity could not be rejected. Based on the result of a Hausman test, we decided to treat constraint as an exogenous variable, although we cannot conclusively state that

Table 2: Correlation Table

	1	2	3	4	5	6	7	8	9	10	11
1. Innovative performance	–										
2. Constraint	0.17	–									
3. Network overlap	−0.15	0.33	–								
4. Number of alters (network size)	0.28	0.69	−0.21	–							
5. Years of education	0.21	0.10	0.00	0.16	–						
6. Age	0.01	0.02	−0.03	0.03	−0.19	–					
7. Gender (female = 1)	−0.11	−0.16	0.03	0.23	−0.10	0.10	–				
8. Region (rural = 1)	0.19	0.26	−0.06	0.38	0.07	0.09	−0.06	–			
9. Customer oriented	0.14	−0.05	−0.01	−0.09	−0.01	−0.05	0.16	−0.31	–		
10. Agricultural	0.01	0.08	0.00	0.11	−0.03	0.21	−0.08	0.39	−0.31	–	
11. Manufacturing	0.09	0.12	−0.06	0.15	−0.01	−0.10	−0.07	0.33	−0.27	−0.15	–
12. Bank credit	0.15	0.08	−0.03	0.08	0.04	0.07	0.05	0.18	0.04	0.04	0.17

Note: Coefficients $>|0.07|$ are significant.

Table 3: Means and Standard Deviations of the Study Variables for the Total Sample and Urban and Rural Samples

	Total sample		Urban sample		Rural sample	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Innovative performance	2.39	1.89	2.02	2.00	2.76	1.67
Constraint	1.71	0.91	−0.23	0.92	0.24	0.83
Network overlap	0.51	0.43	0.54	0.45	0.49	0.42
Number of alters (network size)	3.95	2.29	3.09	1.96	4.82	2.78
Years of education	8.81	3.70	8.55	4.21	9.07	3.09
Age	31.5	10.8	30.49	9.43	32.45	11.91
Gender (female = 1)	0.42	0.49	0.45	0.50	0.39	0.49
Region (rural = 1)	0.49	0.50				
Customer oriented	0.36	0.48	0.51	0.50	0.21	0.41
Agricultural	0.14	0.35	0.01	0.09	0.28	0.45
Manufacturing	0.12	0.32	0.01	0.12	0.22	0.42
Bank credit	2.86	0.80	2.72	1.06	2.99	0.31

endogeneity poses no statistical problem. The Hausman test depends on the assumption that there is no covariance between our instruments and the residual.

Table 4 presents the regression results for the total sample and separately for urban and rural subsamples. The regression results reproduced for the total sample in are consistent with our hypothesis 1 concerning a U-shaped relationship between constraint and innovative performance. Constraint has a positive and significant coefficient, while the coefficient of constraint squared is significant and negative. It indicates that, at first, increasing constraint has a positive effect on innovative performance. However, as can be seen in Table 4, if we estimate the model separately for the urban and rural samples, we only find a significant relation between constraint and innovative performance in the urban sample.[12] So, hypothesis 1 is fully supported for the urban sample, but not for the rural one. In Figure 3, we use the unstandardised regression coefficients from the urban sample to plot the predicted U-shaped relationship between our constraint measure and innovative performance.[13]

[12] We thank an anonymous reviewer for the suggestion to run separate regressions for the subsamples.

[13] Analyses not tabulated here suggest that suboptimal networks with very low constraint are networks of less well-educated entrepreneurs.

Table 4: Determinants of Innovative Performance

	Rural sample	Urban sample	Total sample
Constraint	0.053 (0.19)	0.588 (2.99)**	0.559 (3.63)***
Constraint squared	−0.014 (−0.13)	−0.510 (−3.82)***	−0.357 (−5.54)***
Network overlap	0.219 (0.62)	−1.714 (−5.81)***	−0.968 (−4.39)***
Number of alters (network size)	0.003 (0.03)	0.035 (0.38)	−0.051 (−0.87)
Years of education	0.060 (1.90)	0.082 (3.69)***	0.088 (4.87)
Age	0.005 (0.69)	0.015 (1.46)	0.008 (1.28)
Gender (female = 1)	−0.419 (−2.20)*	−0.009 (−0.05)	−0.248 (−1.82)
Region (rural = 1)			0.498 (3.00)***
Customer oriented	0.169 (0.64)	0.850 (4.28)***	0.724 (4.60)***
Agricultural	−0.319 (−1.32)	−0.275 (−0.61)	−0.062 (−0.28)
Manufacturing	0.237 (0.95)	−0.403 (−0.69)	0.348 (1.52)
Bank credit	0.243 (1.21)	0.109 (1.19)	0.174 (2.06)*
Constant	1.361 (1.62)	1.572 (2.38)	1.409 (2.83)**
Number of observations	358	338	696
F	1.96* (11, 346)	22.21*** (11, 326)	15.12*** (12, 683)
R^2	0.03	0.39	0.21

Note: *T*-values are between brackets; robust standard errors.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

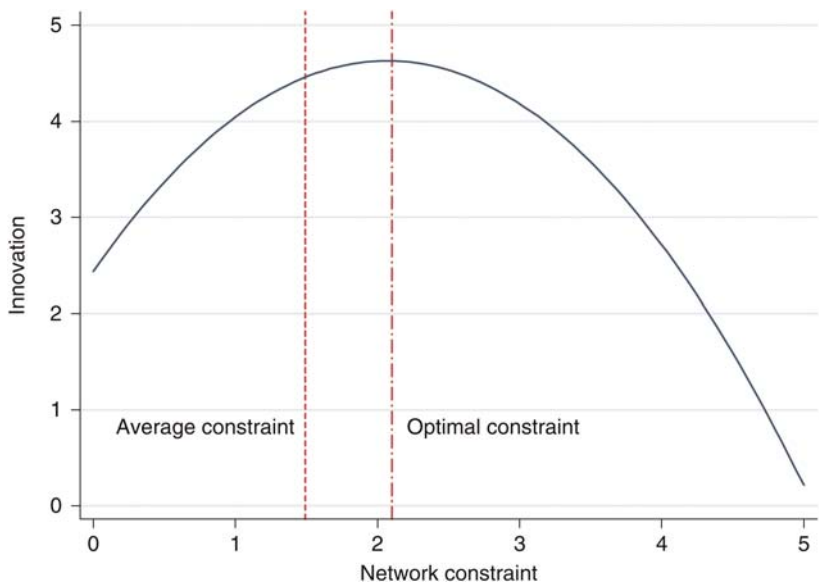

Figure 3: The Empirical Relationship between Constraint and Innovation (Urban Sample)

The difference between the results for the urban and rural samples suggests that the relationship between constraint and innovative performance is context dependent. This is an interesting area for further research. One tentative explanation of these findings focuses on cultural influences. Entrepreneurs in rural areas tend to be more collectivistic, and recent research suggests that the effects of constraint may be dampened in collectivistic cultures. The informational benefits of open networks are less easy to materialise due to the communal sharing values (Xiao and Tsui, 2007).

Our second hypothesis states that the greater the overlap of personal and business networks, the less innovative an entrepreneur will be. In Table 4, the coefficient of network overlap is highly significant and negative for the total sample and the urban subsample. This is consistent with the second hypothesis. In a further analysis not reproduced here, we entered a squared term of the overlap variable. This was not significant. There was no indication that the relation between network overlap and innovation was non-linear (as in the case of the relationship between the constraint and innovation). Just as in the case of the first hypothesis, the second hypothesis is supported only by the data for the urban sample. There is no significant effect of network overlap in the rural sample.

As our dependent variable in Table 4, we used a five-item scale to measure the latent variable innovativeness (Table 1). Each of these five items measures different aspects of innovative behaviour and captures actions spanning from the introduction of new or improved products and processes to investment in and improvement of the existing capital. It is not impossible that constraint will affect investment and innovation differently.[14] Innovation is a more information-demanding activity, while investment is a more material resources-demanding activity. Since information benefits will especially be more negatively affected by higher levels of constraint, the non-linear effect of constraint should be stronger for innovation than for investment. There could also be differences in the effects of network overlap.

To further disentangle the effects of network characteristics on innovative performance, we therefore construct two dependent variables capturing different aspects of innovation. The first variable is a binary investment variable based on items 1 and 2 in Table 1 (1 = entrepreneur has invested resources, 0 = entrepreneur has not invested resources). The second variable is a binary innovation variable based on items 3 and 4 of Table 1 (1 = entrepreneur has innovated, 0 = entrepreneur has not innovated) (Table 5).

[14] We thank an anonymous reviewer for this suggestion.

Table 5: Logistic Regression Analyses of Investment and Innovation (for the Urban Sample)

	Investment			Innovation		
	Coefficient estimate	Standard error	*T*-value	Coefficient estimate	Standard error	*T*-value
Constraint	1.135***	0.297	3.82	0.781*	0.314	2.49
Constraint squared	−0.597*	0.235	−2.54	−1.184***	0.218	−5.44
Network overlap	−2.566***	0.493	−5.21	−2.146***	0.485	−4.43
Number of alters (network size)	−0.091	0.139	−0.65	−0.142	0.146	−0.97
Years of education	0.075*	0.033	2.28	0.124***	0.035	3.49
Age	0.018	0.014	1.23	0.030*	0.014	2.13
Gender (female = 1)	0.126	0.280	0.45	−0.350	0.290	−1.21
Customer oriented	0.819**	0.271	3.02	0.716	0.276	2.60
Agricultural	0.482	0.898	0.54	−0.372	1.491	−0.25
Manufacturing	0.712	1.124	0.63	–	–	–
Constant	0.420	0.948	0.44	0.267	1.031	0.26
Number of observations	344			339		
Wald χ^2 (df)	72.83(10)			124.40(9)		
Pseudo-R^2	0.24			0.27		

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

The inverted U-shaped relation between network constraint and the dependent variable is confirmed for both dependent variables in the urban sample.[15] But, a Wald test of the difference of the coefficients in the investment and innovation regression (after combining the estimation results and the associated (co)variance matrix) revealed that the difference between the coefficients of the constraint variables is significant ($\chi^2(2) = 8.54$, $p = 0.014$). As can be seen in Figure 4, the optimal level of constraint is lower in the case of innovative performance than in the case of investment. This means that negative effects of increasing constraint set in earlier in the case of innovation. This is an interesting and plausible result. It suggests that constraint is more of a threat to information flows than to material flows which will affect investment.

The finding that controlled for network constraint—network size has no effect—may have implications for future economic research on peer effects in technology adoption. This kind of research typically focuses on interpersonal relations in technology adoption, but does not take into account that

[15] Consistent with our previous findings, there were no inverted U-shaped relationships in the rural subsample.

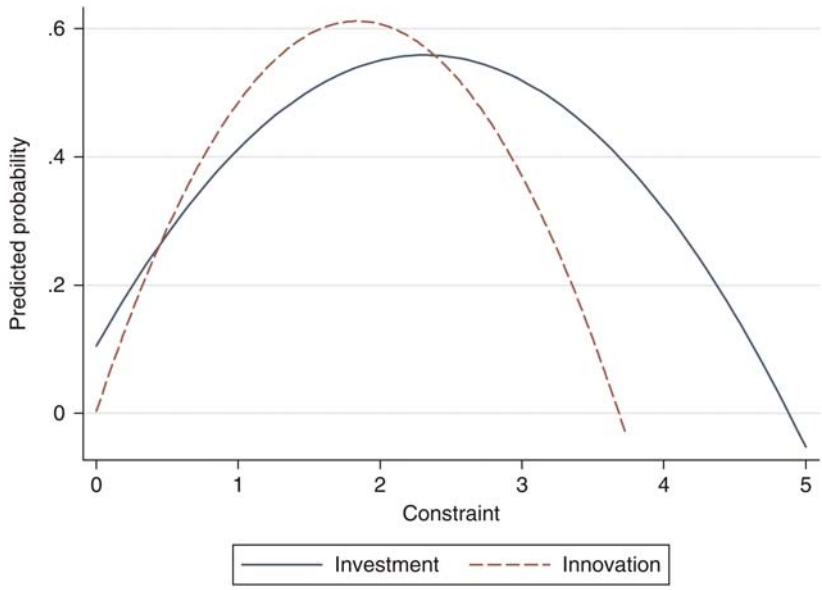

Figure 4: The Empirical Relationships between Constraint and Innovation and Constraint and Investment (Urban Sample)

the relationships among those relationships may also affect technology adoption decisions. For instance, Bandiera and Rasul (2006) found that decisions to adopt a new crop by farmers in Mozambique were related to adoption choices of their peers. They found an inverted U-shape: adoption effects are positive when there are a few adopters, and negative when there are many adopters. In our study, we found that (in urban regions) innovative performance—which is related to technology adoption—is mainly affected by the structure of the network, not the number of peers. A recent example of research on network formation that includes indirect contacts is Comola (2010).

With regard to the control variables, we find that rural entrepreneurs are more innovative than urban entrepreneurs. Female entrepreneurs are less innovative, especially in the rural regions. We also find that entrepreneurs with access to bank credit are more innovative. Entrepreneurs who operate in the customer-oriented sector are more innovative.

In an analysis not tabulated here, we tested various alternative specifications of the model. We also included a number of network variables, such as the heterogeneity of the network in the equation to check whether they affected our results. Our key finding of an inverted U-shaped relationship

in setting between constraint and innovative performance was very robust for all specifications in the urban subsample. We divided the sample into males and females and checked whether coefficients differ between the samples—they did not. We also tested whether constraint was correlated with our presumed mechanisms, namely trust and information access. In the questionnaire, we asked respondents to what degree business partners broke agreements. It turns out that networks with higher levels of constraint have lower levels of broken agreements ($r = -0.14$; $p < 0.001$) and hence, higher levels of trust. There is no significant relation between opportunity recognition and constraint.

To further check the robustness of our results, we performed a number of further regression diagnostics. We identified four outliers. Removing them did not substantially alter the results. Most of the coefficients became slightly more significant. We used ten interviewers to collect the data. We checked whether interviewer bias could have affected the results. We did this by including nine interviewer dummies in the analysis. The results were not substantially affected. All the coefficients that were significant in Table 3 remained significant and the signs remained unchanged, though some of the standard errors of coefficients did show some increase. We found no signs of heteroskedasticity of the residuals. However, a normal probability plot revealed that the distribution of the residuals deviated slightly from a normal distribution. Finally, we checked for multicollinearity. No problems were detected: the average variance inflation factor was 1.64, while no individual variance inflation factor exceeded 3.

6. Conclusion

In this article, we have examined the relationship between social capital and entrepreneurial innovation in an African context. Social capital refers to resources that are embedded in a durable network of relationships. We integrated two perspectives on the relation between networks and social capital. One view argues that clique-like closed networks are beneficial for cooperation and resource sharing, which is often needed to implement an innovation. The other view argues that closed networks *constrain* entrepreneurs. Entrepreneurs invest time and energy in 'redundant' contacts that are related among themselves, and as a consequence do not provide access to fresh heterogeneous sources of information. Integrating the two perspectives, we hypothesised that the relationship between the degree of constraint of a network and innovative performance has an inverted

U-shape. We also hypothesised that network overlap is negatively related to innovation.

We used data from a theoretically tailored survey including detailed questions about networks and network characteristics, held in May 2008, among Ugandan entrepreneurs from urban and rural regions.

In the sample of urban entrepreneurs, we found clear support for our hypothesis. We argue that the U-shaped relationship is caused by two opposing forces that operate simultaneously. On the one hand, networks help solve information problems. Via his/her contacts, an entrepreneur can access information about new technologies, markets and business opportunities. On the other hand, networks help solve cooperation problems. To implement innovations, entrepreneurs will need support that can be provided by their contacts. If network constraint is high, that is, if there are many connections between the entrepreneur's relations, cooperation problems are more easily solved. But, such constrained networks are less well suited for the acquisition of novel heterogeneous information.

The second hypothesis examined in this paper focuses on network overlap. It states that network overlap is negatively related to innovative performance. In this paper, three types of networks have been distinguished: personal networks, information networks and business support networks. We have constructed an indicator which measures the overlap between personal networks, on the one hand, and business and information networks, on the other. For our urban subsample, we find a significant negative relationship between this indicator and innovative performance, which is in line with our second hypothesis.

Interestingly, we do not find any support for our two hypotheses concerning network constraint and network overlap in a rural setting. The hypotheses are confirmed for the total sample, but when one re-runs the regressions for a rural subsample, all coefficients become non-significant. The results for the total sample are clearly driven by those for the urban subsample.

At this stage, we can only provide tentative explanations for the difference between urban and rural settings. Research in intra-organisational settings suggest that the effect of networks may depend on the cultural context of the network (Xiao and Tsui, 2007). The idea that some relationships are 'redundant' is inherently individualistic, in the sense that it starts from the premise of an independent self, gives priority to individual goals rather than collective goals and focuses on fulfilling self-interest rather than accommodating to social norms and obligations. Xiao and Tsui (2007) present evidence that, in organisations within collectivistic cultures,

network constraint is not related to social capital. The possibility that networks function differently in urban and rural African contexts is a fruitful avenue for future research.

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