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Innovation and Social Capital: A Cross-country Investigation

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Abstract

This study explores the impact of social capital on innovation by constructing a more general measure of social capital indicator consisting of generalized and institutional trust, associational activities and civic norms. We test the hypothesis that social capital has a positive impact on innovation at the national level. After controlling for R&D expenditure and human capital there is a positive relationship between social capital and innovation. Social capital interacts with entrepreneurship and the strongest relationship is between associated activities and entrepreneurship. This is consistent with the need to build social relationships in today's networked economy.

JEL-classification: L26, J24, O31, O5

Keywords: human capital, social capital, entrepreneurship, innovation, generalized and institutional trust, civic norms, associational activities

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1. Introduction

In the knowledge-based economy innovation is conceived of as a process involving social interaction and is no longer achieved by isolated individuals. Innovation, the process of introducing a new product of service to the market (Acs and Audretsch, 1988), is an interactive process involving both formal and informal relationships between firms or organizations with the different actors of their environment in networks. Innovation is explained by the combination of intangible forms of capital (Landry *et al*., 2002). Basic R&D in conjunction with social capital (trust, technological networks and collaboration and partnership) between actors is an important source of innovation. High level of social capital has a positive effect on innovation (Dosi, 1988; Hofstede, 1991; Maillat and Lecoq, 1992; Maillat, 1995, 1998; Storper, 1995; Triandis, 1995; Knack and Keefer, 1997; Fountain, 1999). In particular, social capital contributes to innovation because the high level of social capital can reduce transaction costs between actors, reduce search and information costs, bargaining costs, and decision costs (Maskell, 2001; Landry *et al*., 2002).

The impact of social capital on innovation at the national level has been understudies. Most prior studies examining the impact of social capital on innovation have several limitations. First, previous studies have mainly focused on processes taking place at the regional level (i.e. Saxanian, 1994; Storper, 1995; Maskell and Malmberg, 1999; Bellandi, 2001; Bathelt, 2003; Beugelsdijk and van Schaik, 2005). The impact of social capital on innovation can be different depending on the analytical level: national vs. regional levels. In addition, the relationship between social capital and innovation has found conflicting results, either positive (Coleman, 1988, 1990; Putnam, 1993a; Knack and Keefer, 1997; Onyx and Bullen, 2000), negative (Chou *et al*, 2006, Dasgupta, 2000) or both (Fukuyama, 1999), or partial positive effect of trust and associational activity (which are sub-constructs of social capital) on innovation (Dakhli and de Clercq, 2004).

Second, the indicator to measure the level of social capital of each country or region is not well developed. Despite the popular and frequent use of the concept, there is still a lack of agreement on the definitions and measurements of social capital, perhaps because of the multidimensional characteristics of the concept (Beugelsdijk and van Schaik, 2005). Thus, the definition, constructs, and measurement of social capital depend on the researcher and on

"whether they focus on the substance, the sources, or the effects of social capital" (Adler and Kwon, 2002: 19). Recently, Dakhli and de Clercq (2004) examine the effect of human capital and social capital on innovation based on processes and phenomena at the national level. However, they fail to produce an indicator to measure the level of social capital and fail to examine more in-depth the nature of the relationship between social capital and innovation.

Third, there is no generally accepted empirical model considering the impact of social capital on innovation as an interactive process. It is necessary for researchers to consider human capital, entrepreneurship, and social capital as drivers of innovation in an empirical model to describe the relationship between those three factors and innovation in detail.

The purpose of this study is to add to the literature on innovation and social capital and empirically test the impact of social capital on innovation at the national level. This study produces a more relevant indicator of social capital at the national level based on levels of trust (generalized trust and institutional trust), associational activity (active and passive membership), and civic norms which are mentioned as the core components of social capital in previous empirical studies. The data are from the World Value Survey Association taken from the 4th wave World Values Survey (2000) and 5th wave World Values Survey (2005). By merging the two surveys, we have a much larger dataset. The scores of all of these constructs of social capital are replaced into a scale of 100 points in this study. This study uses the mean value of each construct of social capital of each respondent in each country. The social capital index in this paper is measured as an un-weighted and weighted mean value of trust, associational activity, and civic norms. The econometric analysis enables the testing of two hypotheses: (1) social capital has a positive impact on innovation at the national level; and (2) the higher the levels of social capital in each country result in higher innovation.

This paper suggests that generalized and institutional trust, associational activities, and civic norms are three core components that define social capital at the international level. Consequently, the authors of this paper hypothesizes that the innovation is not only dependent on the accumulation of R&D, human capital, and entrepreneurship which are well known drivers of innovation, but it also is influenced by the accumulation of social capital. Thus, it can be said that higher levels of R&D, human capital, entrepreneurship, and social capital are positively correlated with higher levels of innovation at the country level. The next section of this paper

reviews the literature on social capital and innovation. Section three presents the date, methodology and empirical model. The results and discussion are in section four. We finish with the conclusion.

2. Social Capital and Innovation

Social capital is one of the popularly and frequently used concepts to explain the innovative process. Social capital theorists suggest that innovation can be increasingly generated by social capital and the high level of social capital is not only vital for the effective functioning of societies but it also has a positive effect on innovation in the new knowledge economy. They also argue that the economic actors with low level of social capital in the new economy might have an experience of unwieldy transaction costs, search and information costs, bargaining costs, decision cost (Maskell, 2001; Landry *et al*., 2002), lack of coordination, duplications of effort, and costly contractual dispute (Fountain and Atkinson, 1998).

While there is no general agreement on the construct and measurement of social capital, several studies provide useful information for us to understand the definition of social capital. For example, the World Bank defines social capital as "the norms and social relations embedded in social structures that enable people to coordinate action to achieve desired goals" (World Bank, 1985: 29). Coleman (1990) defines social capital as not a single entity, but a variety of different entities consisting of some characteristics of social structure, which facilitates certain actions of actors within the social structure.

Bourdieu and Wacquant define social capital as "the sum of the resources, actual or virtual, that accrue to an individual or a group by virtue of possessing a durable network of more or less institutional relationship of mutual acquaintance and recognition"; therefore, social capital facilitates actor's specific activities in the social network (Bourdieu and Wacquant, 1992: 119). Putnam (1995) characterizes social capital as trust, network structures, and norms that promote cooperation among actors within a society for mutual benefit. Thus, Putnam (2000) suggests formal membership, civic participation, social trust (generalized trust), altruism (volunteerism) as indicators of social capital.

Fukuyama (1995) not only regards trust as the core indicator of social capital but also suggests that this trust can be accumulated by cooperation within the civic participation network.

Onyx and Bullen (2000) discuss social capital in terms of trust, participation in networks, reciprocity, the commons, social agency, and social norms. Glaeser and Redlick (2008) suggest that social capital can be built through group membership and political activism. Adler and Kwon (2002) review a wide range of literature on the definitions of social capital, and they suggest that the definitions of social capital can be categorized into three broad types depending on whether they focus on an actor's relations with other actors (bridging view), on the structure of relations between actors within a collectivity (bonding view), or a combination of both perspectives. It can be concluded from the above studies that social capital includes several core components: mutual trust, associational activities or membership (including cooperation and participation), and civic norms.

If social capital has these core components, then what are the roles and potential of social capital in innovation? And how do the different dimensions of social capital affect innovation? First, previous studies on trust suggest that trust can be a stimulus to innovation both within organizations and in inter-organizational environments by lessening the need for tight monitoring and control mechanisms, increasing the freedom from rigid rules, and therefore enhancing idea generation through interactions between individuals within an organization and inter-organizational cooperation (Quinn, 1979). Trust has been one of the core values for social exchange and communication; therefore, individuals, firms or organizations need to have mutual trust with other actors within a country if they want to increase the efficiency and productivity by reducing the need for time and monitoring cost.

Trust has multidimensional characteristics and cultural aspects; therefore, there are various forms of trusts in terms of the various perspectives of economics, psychology, sociology, etc. (Rousseau *et al*., 1998). Based on prior studies, Dakhli and de Clercq (2004) categorized trust as a driver for promoting innovation at the societal level into two types: generalized trust and institutional trust. Generalized trust is related to what people have in other people in a certain society. Institutional trust is related to what people have in organizations or institutions in a certain society. The first type of trust captures the interpersonal facet of trust, and thus, it can be assumed to reduce uncertainty and facilitate interaction and communication (Sako, 1992; Beugelsdijk and van Schaik, 2005).

The second type of trust captures the deterrence basis for trust. If people think the organizations or institutions in a given society contribute to the mediation of exchange and communication and protect actors against any breach of contract, they are more willing to interact with other actors. Putnam (2000) argues that "a society that relies on generalized reciprocity is more efficient than a distrustful society" and "honesty and trust lubricate the inevitable frictions of social life" (Putnam, 2000: 135). Fukuyama (1995) regards trust and honesty as drivers for reducing transaction costs. Akçomak and ter Weel (2006) identify trust, as a proxy of social capital foster innovation and the innovation is "an important mechanism that transforms social capital into economic growth" (Akçomak and ter Weel, 2006: 3). According to the above brief description of trust, it can be said that these two types of trust, generalized and institutional trust, contribute to reduce transaction costs and monitoring costs, promote actors in a given society to cooperate and to share various resources, such as information, skills, and knowledge, and reduce the need for intervention to prevent dishonesty. Thus, it makes it possible for a society to promote innovations of the society.

Second, associational activity refers to the tendency for citizen membership in associations and voluntary types of organizations (Knack and Keefer, 1997). Despite popular studies on the definitions of associational activities, the arguments on how embeddedness in social networks and the closure of the network affect are less developed compared with the arguments on the role of trust (Beugelsdijk and van Schaik, 2005). Even so, there are several studies (Coleman, 1988, 1990; Putnam 1993a; Burt, 1992, 1997a, 1997b; Uzzi, 1999; Gargiulo and Benassi, 2000; Beugelsdijk and van Schaik, 2005) that examined the effect of associational activities on innovation. Coleman argues that the closure of social networks and cohesive ties have positive effects on promoting a normative milieu that facilitates trust, cooperation, and interaction between actors. Putnam (1993a) mentions that in regions with social relationships, which are based on trust, shared values, mutual support, and solidarity, there is higher participation in social organization and a higher level of social capital.

Thus, they stressed that more dense social networks positively affect the level of trust and citizenship. From this social capital perspective, people in the dense networks can learn new technologies, ideas, and opportunities necessary to innovation quickly because of the density of interaction within a collaborative network (Fountain and Atkinson, 1998). For example,

entrepreneurs' relationships with other actors in their social networks can play an important role in the decisions about new start-up and growth because an entrepreneur's social networks can increase alertness to business opportunities (Ardichvili *et al.*, 2003); can help in discovering entrepreneurial opportunities and gaining access to knowledge and information about innovation (Hessels, 2008).

Furthermore, Beugelsdijk and van Schaik (2005) suggest that the benefits of the embeddedness of social networks cannot be captured by taking passive membership, such as the number of organizations that individual belongs to. To capture the benefits of network embeddedness with validity, the level of organization involvement needs to be considered. This level can be examined by the degree to which one participates actively in the organizations to which they belong. However, Burt stress that the lack of network closure and weak-ties is much more important to create the benefits from social networks and decreases the rigidity of the structure of organizations. In Burt's perspective, structural holes are the main sources to get new and useful information necessary for innovation. Thus, the debate between these two approaches on social networks has been heating up between the traditional theorists and structural-hole theorists of social networks. Uzzi (1999) and Gargiulo and Benassi (2000) explore this tension between the two opposite approaches on how social networks create social capital. Specifically, Uzzi (1999) suggests that embedded ties can facilitate partners in the network to share private information and other resources that are not easily available, while arms length ties can be useful to obtain public information and resources, and thus different types of ties may appear within one network to get the benefits from social networks.

Gargiulo and Benassi (2000) also argue that there is a trade-off between the safety of cooperation within cohesive networks and the flexibility of networks with weak-ties but which are rich in structural holes. Considering these discussion of social networks, it can be said that associational activity through passive and active membership in multiple organizations (regardless of strong-ties or weak-ties in the networks) can be an important factor for making it possible for individuals in a given society to make contact with other members of organizations with various backgrounds, information, and knowledge. Hence, it can contribute to increase information and knowledge exchange and facilitate the innovation and development of social

capital in a society. Consequently, areas with high levels of social capital can enjoy higher levels of innovation.

Third, civic norms refer to the general tendency of citizens in a given society to cooperate and to weight the public good relatively to self-interest (Knack and Keeper, 1997; Dakhli and de Clercq, 2004). These informal mechanisms are often said to coexist with associational activities because people who want to improve their societies' well-being may be more likely to participate in various activities of their societies, to exchange their information, ideas and knowledge with others, and to try to reach a consensus on the ideal state that is best for all people (Dakhli and de Clercq, 2004). However, it can be said that a civic norm is a concept that is different from associational activities in that the goal of individuals' associational activities depends on organizations, although being a member of an organization is related to the increase in the level of associational activities and civic participation. Regarding the role of civic norms in innovation, Argyle (1991), Knack and Keefer (1997), and Dakhli and de Clercq (2004) argue that civic norms may foster innovation through their effect on cooperation and the exchange of ideas or knowledge among members with different backgrounds and specialties in organizations. Thus, the more a society is civic, the higher the tendency to share useful information and knowledge is, and thus the higher the innovation. In addition, some other studies mention that corruption is also an important point of civic norms when we discuss the role of civic norms in innovation. Veracierto (2008) argues that corruption can lower the rate of product innovation in an industry by three major agents: an innovator, an incumbent producer, and a corrupt government official. According to the result of Veracierto (2008)'s analysis, the amount of resources are inversely related to the bribes that producers must pay when "the innovator wants to enter business by potentially paying a bribe; the incumbent producer wants to preclude the entry of the innovator by potentially paying a bribe; and the corrupt official decides on allowing the entry of the innovator based on the bribes received" (Veracierto, 2008: 29). Thus, the resources necessary to innovation cannot be devoted to innovation because of this continuous and inverse bribe system; therefore, it can be said that corruption is negatively related to innovation.

3. Data and Methodology

3.1. Data and Variables

This study uses macro and micro data for the empirical analysis at the country level. As mentioned previously, human capital, entrepreneurship, and R&D are well known drivers of innovation. Thus, this study considers these three factors in the analytical model of innovation. First, as the dependent variable, innovation is measured by the number of the US utility patent of each country. There are several important limitations of patent measures as an indicator of innovation, such as the difference between innovations and inventions (Edwards and Gordon, 1984), inability of capturing all of the innovations actually made (Acs and Audretsch, 2005), the uncertainty about the stability of the propensity to patent across firms and across industries (Scherer, 1983), enormous variation of the value and cost of individual patents within and across industries (Mansfield, 1984), and misleading of comparisons both within-industry and between-industry (Cohen and Levin, 1989).

Thus, the reliability of the patent data as measures of innovation has been severely challenged, although new and superior patent data sources such as the new measure of patented inventions from the computerization by the U.S. Patent Office and in Europe have been introduced (Acs and Audretsch, 2005). To overcome these limitations of patent measures, it can be recommended to use the literature-based innovation data but the data is not accumulated enough for scholars to use in their analyses. Thus, this study uses patent measures as an indicator of innovation. Based on the empirical analysis of an econometric knowledge production function (KPF) model, Acs *et al.* (2002) also suggest that the measure of patented invention provide a fairly reliable measure of innovation activity, although not perfect, representation of innovative activity (Acs *et al*, 2002).

Second, for an indicator of human capital at the international level, this study will use the Human Development Indicator developed by the UNDP, which consists of the level of educational attainment, life expectancy, and standard of living. The previous literature also suggests those three sub-indicators as the core components of human capital.

Third, this study uses the Global Entrepreneurship Index (GEI) recently produced by Acs and Szerb (2008) as a proxy of entrepreneurship measure although previous study such as Audretsch and Keilbach (2004) use the number of start-ups to measure the level of

entrepreneurship. Some other studies also used other good indicators for entrepreneurship, such as the Kauffman index of Entrepreneurial activity and the GEM entrepreneurship index. But, those indices cover only a selected number of countries, not enough for the empirical analysis of this study. Furthermore, GEI is a good indicator because not only it captures the contextual features of entrepreneurship at each stage of development but also suggests the importance of entrepreneurship in the innovation (Acs and Szerb, 2008).

Fourth, it is well known that R&D is an input and not an output in the innovation process therefore it is significantly contributable to innovation. Recently, Acs and Audretsch (1988, 2005) argue that innovation is positively related to R&D expenditure and skilled labor. Thus, this paper will consider the level of R&D expenditure of each country in the empirical model when we measure the impact of human capital, entrepreneurship, and social capital on innovation.

Fifth, this paper includes several control variables, such as, country size, income gap, and unemployment rate because these variables may have an influence on country-level innovation. According to Dakhli and de Clercq (2004), there is a higher rate of exchange in terms of all types of resources at multiple levels in larger countries. Thus, there is a tendency for larger countries to have higher levels of innovation. Prior research such as Knack and Keeper (1997) and Dakhli and de Clercq (2004) also mentioned that the income gap, which reflects how well income is distributed among people in a given country, may have an (negative) effect on innovation. For that reason, this paper includes the income gap as a control variable in the analytic model. The unemployment rate is generally regarded as one of the important factors in innovation in each country in terms of traditional economic theories. As such, this paper also includes the unemployment rate as a control variable. Finally, this paper uses the natural log value of total population, the GINI index, and the unemployment rate of total labor force in each country as a proxy of country size, the income gap, and the status of people's economic activities, respectively.

3.2. Measurement of Social Capital

Previous studies mainly use the World Values Survey dataset to measure the level of social capital at the country level. Among them, this study summarizes five methods adopted by Knack and Keefer

(1997), Whiteley (2000), Bjørnskov and Svendsen (2003), Dakhli and de Clercq (2004), and Beugelsdijk and van Schaik (2005) because these methods are cited in many other studies. Of course, as social capital measures, Narayan and Pritchett (1999) and Krishna and Uphoff (1999) also use 'generalized trust' and 'voluntary organization'; Brehm and Rahn (1997) use 'generalized trust,' 'trust in government,' and 'civic participation'; Rose (1999) use 'network' and 'trust in government'; and Putnam (1993) and Grootaert (1999) use 'voluntary organizations.' But, they use various kinds of datasets; therefore, it is difficult to compare social capital measures in one study with those in other studies. Thus, this study focuses on the empirical studies using the WVS dataset. Table 1 summarizes the methodology of these three empirical studies by using the World Values Survey to measure the level of social capital of each country.

Table 1 Methodology to Measure the Level of Social Capital in Previous Empirical Studies

Constructs		Knack and Keefer (1997)	Whiteley (2000)	Bjørnskov and Svendsen (2003)	Dakhli and de Clercq (2004)	Beugelsdijk and van Schaik (2005)
Trust	Generalized Trust	Percentage (1) 2 scales	Score (3) 1 item: 2 scales 2 items: 5 scales	Percentage (1) 2 scales	Percentage (1) 2 scales	Percentage (10) 2 scales
	Institutional Trust				Average score (16) 4 scales	
Associational Activity (Membership)		Average number of groups cited per respondent in each country (10)		Average number of groups cited per respondent in each country (16)	Average score (9) 3 scales	Average number of passive and active membership: • Passive membership: Average number of groups cited per respondent (15) • Active membership: Average number of groups cited per respondent (15)
Norms of Civic Behavior		Average score (5) 10 scales			Average score (5) 10 scales	
Method to Calculate the Level of Social Capital		Using each component separately	Using mean factor scores calculated from all of the respondents within a country	Using each component separately	Using each component separately	Using factor score by factor analysis
Cases		29 countries	34 countries	32 countries	59 countries	54 regions in 7 countries
Data Sources		The World Values Surveys, 1990	The World Values Surveys, 1995	The World Values Surveys, 1995	The World Values Surveys, 1995	The European Values Surveys, 1990

The number (in parentheses) means the number of items (of the survey) used to produce each component of social capital

According to Table 1, Knack and Keeper (1997) do not consider institutional trust and thus failed to produce a social capital indicator covering all three dimensions. Whiteley (2000) only consider generalized trust as social capital measure. Bjørnskov and Svendsen (2003) consider generalized trust and membership in their model but they did not include institutional trust and norms of civic behavior in their social capital constructs. Instead, they consider corruption and economic freedom obtained from the Freedom House (2002)[1] measure of political rights and civil liberties in their social capital indicator. Dakhli and de Clercq (2004) consider the dimension of institutional trust in their model; however, they also fail to produce a social capital indicator covering all three dimensions because their results do not show statistically significant correlations between items measuring associational activity and norms of civic behavior. Thus, these two studies describe just piecemeal dimensions of social capital. Beugelsdijk and van Schaik (2005) succeed in producing a social capital indicator by using a factor score based on the results of factor analysis. But, they only consider generalized trust and associational activity as constructs of social capital; therefore, they also fail to produce a social capital indicator covering all three dimensions appropriately.

In sum, previous empirical studies on social capital measurement fail to consider all three of the core constructs of social capital appropriately when they measure the level of social capital; therefore, they fail to produce a social capital indicator covering all three dimensions of social capital. In order to fully understand and to measure various dimensions of social capital appropriately, it is important to produce a social capital indicator covering all three components of social capital.

Trust is expressed as un-weighted and weighted mean of each score of generalized trust and institutional trust. Generalized trust is measured by asking the respondents: "Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?" The generalized trust indicator in this study is the percentage of respondents in each country that responded that 'most people can be trusted.' Institutional trust is measured by asking

[1] Freedom House (www.freedomhouse.org), a non-profit, publishes an annual assessment of economic freedom in the world. Each country is included in one of three categories: free, partly free, or not free by averaging overall rating on political rights and civil liberties. "The political rights and civil liberties categories contain numerical ratings between 1 and 7 for each country or territory, with 1 representing the most free and 7 the least free. The status designation of Free, Partly Free, or Not Free, which is determined by the combination of the political rights and civil liberties ratings, indicates the general state of freedom in a country or territory" (http://www.freedomhouse.org/template.cfm?page=351&ana_page=352&year=2009).

the respondents how much confidence they have in a variety of organizations or institutions, such as the government or parliament. The respondents can choose a number from 1 (a great deal of confidence) to 4 (no confidence at all). The scales are reversed so that larger values reflect greater institutional trust, and we average the values over six items.

Associational activity is expressed as un-weighted and weighted mean of each score of passive and active memberships. Passive membership and active membership are measured by asking the respondents whether they are a passive or an active member of various organizations, including professional associations, political parties, respectively (Knack and Keefer 1997; Dakhli and de Clercq, 2004; Beugelsdijk and van Schaik, 2005). We use an average number of organizations to which each respondent belongs.

Civic norm is expressed as un-weighted and weighted mean of each score of norms of civic behaviors and corruption perception index (by Transparency International, 2005). Based on prior studies (Knack and Keefer, 1997; Dakhli and de Clercq, 2004), this study measure norms of civic behaviors by asking the respondents whether a list of four behaviors 'can always be justified, never be justified or something in between.' The behaviors such 'cheating on taxes if you have a chance' and 'someone accepting a bribe in the course of their duties' are included in the four civic behaviors. The respondents choose a number from 1 (never justifiable) to 10 (always justifiable) and we reverse the scales thus larger values reflect greater norms of civic behaviors. The Corruption Perception Index produced by Transparency International relates to the perceived level of corruption of each country, as determined by expert assessments and opinion surveys. The score ranges between 10 (highly clean) to 0 (highly corrupt).

It is generally said that the application of proper weights is a crucial point of an index building. Some indexes such as Global Competitiveness Index use a sophisticated methodology and econometric techniques to determine the appropriate weights (Acs and Szerb, 2008). But most of indexes do not use weighing method. That is because not only they want to avoid the accusation of using arbitrary methodology, but it can also be calculated in relatively easy and interpreted straightforward by readers (Acs and Szerb, 2008). This study uses both (un-weighted and weighted) methods in the development of social capital index because there is no well established weighting method in the area of social capital research. This can also provide much more information on the impact of social capital index on innovation to readers. The study on this weights and weighted

social capital index based on the weighting method can be one of the important issues of social capital research in the future. Table 2 summarizes the indicators to measure innovation, human capital, entrepreneurship, and social capital and the control variables in this paper. The list of countries is in Appendix A.

Table 2 Brief Description of Each Variable

Variables		Brief Description of each construct			Data Sources
Dependent Variable	Innovation	Patent	Natural log value of the average number of US utility patent of each year during the period from year 2005 to 2007 year		The U.S. Patent and Trade Mark Office
Independent Variables	Human Capital	Human Development Index 2006			UNDP (2008)*
	R&D Expenditure	R&D expenditure (% of GDP); data refer to the most recent year available during the period from year 2000 to year 2005			UNESCO* UNDP*
	Entrepreneurship	Global Entrepreneurship Index			Acs and Szerb (2009)
	Social Capital Index • Unweighted SCI (SCI 1) =(UT+UM+UC)/3 • Weighted SCI (SCI 2) =0.3WT+0.4WM+0.3 WC	Trust • Unweighted Trust (UT) =0.5G+0.5I • Weighted Trust (WT) =0.3G+0.7I	Generalized Trust (G)	Percent of respondents who trust other people generally; the score is replaced into a scale of 100 points.	The 4th Wave World Values Survey (2000) and the 5th Wave World Values Survey (2005) by the World Values Survey Association
			Institutional Trust (I)	Average score of six items [1]; the score (4 scales) is replaced into a scale of 100 points.	
		Associational Activities • Unweighted Membership (UM) =0.5P+0.5A • Weighted Membership (WM) =0.3P+0.7A	Passive Membership (P)	Average number of all eight groups[2] cited per each country; the score is replaced into a scale of 100 points.	
			Active Membership (A)	Average number of all eight groups[2] cited per each country; the score is replaced into a scale of 100 points.	
		Civic Norms • Unweighted Membership (UC) =0.5NC+0.5C • Weighted Civic Norms (WC) =0.3NC+0.7C	Norms of Civic Behavior (NC)	Average score of four civic behaviors[3]; the score (10 scales) is replaced into a scale of 100 points.	
			Corruption (C)	Corruption Perception Index 2005; the score is replaced into a scale of 100 points.	CPI by Transparency International (2005)
Controlling Variables	Total Population	Natural log value of total population of each country 2005			ILO*
	Income Inequality	GINI Index of each country 2005			UNDP*
	Unemployment	Unemployment rate of total labor force of each country (%) 2005			UNDP*
	The 5th Wave	The 5th Wave WVS=1, otherwise=0			The World Values Survey Association

[1] The armed forces, press, labor unions, police, parliament, and civil service are included in these six items.

[2] Religious organization; organization for education, arts, music or cultural activities; labor unions; political parties; human rights; organization for conservation, the environment, ecology, animal rights; professional associations; and organization for sports or recreation are included in these eight groups.

[3] "Claiming government benefits to which you are not entitled," "Avoiding a fare on public transportation," "Cheating on taxes if you have a chance" and "Someone accepting a bribe in the course of their duties" are included in the four civic behaviors.

* These data are collected from each website: UNDP Website (http://hdr.undp.org); ILO website (http://laborsta.ilo.org); and UNESCO Website (http://www.unesco.org).

3.3. Empirical Model

The purpose of this study is to analyze the impact of social capital on the level of innovation at the international level. To test the impact of social capital on innovation, this study extends and changes Audretsch and Keilbach (2004)'s entrepreneurship model ($Y_i / L_i = \alpha(K_i / L_i)^{\beta_1} R_i^{\beta_2} E_i^{\beta_3} e^{\varepsilon_i}$, where *Y* represents economic output, *K* for physical capital, *L* for labor, *R* for knowledge capital, *E* for entrepreneurship capital, and the subscript *i* for regions) with a Cobb-Douglas function form. An empirical model in this study is expressed as "$I_i = \alpha H_i^{\beta_1} E_i^{\beta_2} S_i^{\beta_3} R_i^{\beta_4} e^{\varepsilon_i}$, where *I* represents innovation, *H* for human capital, *E* for entrepreneurship, *S* for social capital, and *R* for R&D expenditure on the condition that population size, income inequality, and the unemployment rate are controlled in the model to account for important factors of innovation and can be transformed this Cobb-Douglas form into the log-linear regression, Equation (1) for innovation.

Equation (1) $$Innovation_t = \beta_0 + \beta_1 H_t + \beta_2 E_t + \beta_3 S_t + \beta_4 R_t + \sum \beta_m X_m + \varepsilon_i$$

Where, β is the coefficient of the each variable, *H* is the human capital, *E* is entrepreneurship, *S* is the social capital, *R* is the R&D expenditure, X is a vector of control variables, *t* refers to time (year 2005), and ε is a random error.

By Equation (1), we can find the relationship between social capital and innovation as well as the relationships between human capital and innovation and between entrepreneurship and innovation. However, we cannot control the interaction between entrepreneurship and social capital by Equation (1). As mentioned previously, social capital, on the one hand, can be an important driver of entrepreneurship. On the other hand, it is also a good driver of innovation. In addition, entrepreneurship can be an important driver of innovation. Thus this study revises Equation (1) to control for the interaction between entrepreneurship and social capital.

Equation (2) $$Innovation_t = \beta_0 + \beta_1 H_t + \beta_2 E_t + \beta_3 S_t + \beta_4 ES_t + \beta_5 R_t + \sum \beta_m X_m + \varepsilon_i$$

Where, β is the coefficient of each variable, *H* is the human capital, *E* is entrepreneurship, *S* is the social capital, ES is the interaction term between entrepreneurship and social capital, *R* is R&D expenditure, X is a vector of control variables, *t* refers to time (year 2005), and ε is a random error.

By Equation (2), we can test the direct impact of social capital on innovation on the condition that the interaction between entrepreneurship and social capital is controlled in the analytical model. Based on this linear regression model, Equation (2) this study will also show the impacts of human capital, entrepreneurship, and R&D expenditure on innovation at the international level in detail and these impacts can be seen in the linear regression coefficient of the human capital, entrepreneurship, and R&D expenditure in each regression model.

4. Results and Discussions

This paper first describes the picture of the relationships among each variable by correlation matrix before showing the impact of social capital and innovation in detail. Table 3 shows the correlation matrix and an analysis of the bivariate correlation coefficients.

Table 3 Correlation Matrix

	Innovation	Human Capital	R&D	Entrepreneurship	Social Capital Index	Total Population	Unemployment Rate	Income Inequality
Innovation	1							
Human Capital	0.634***	1						
R&D	0.803***	0.585***	1					
Entrepreneurship	0.534***	0.719***	0.668***	1				
Social Capital Index	0.543***	0.452***	0.703***	0.842***	1			
Total Population	0.312***	- 0.294***	- 0.043	- 0.436***	- 0.154	1		
Unemployment Rate	- 0.233**	0.005	- 0.277**	- 0.367***	- 0.329***	- 0.075	1	
Income Inequality	- 0.192*	- 0.321***	- 0.439***	- 0.336**	- 0.430***	0.249**	- 0.158	1

* Significance at 10%, ** significance at 5%, *** significance at 1%, two-tailed tests.

First, the human capital, entrepreneurship, and R&D are positively correlated with innovation. Second, R&D expenditure is also highly correlated with innovation. This result is consistent with the model of Acs and Audretsch (1988) and indicates that a country's innovation is positively related to the

R&D expenditure of that country. The social capital index [2] is highly correlated with the entrepreneurship. Human capital is also correlated with the social capital index and R&D expenditure. Prior studies such as Coleman (1988) and Serageldin and Dasgupta (2000) also examine the positive relationship between human capital and social capital. Thus, more in-depth examination of the characteristic of the relationship between human capital and social capital needs to be carried out in future studies, although the discussion about these relationships is out of the question in this study.

The impacts of each construct of social capital and social capital index, on innovation on the condition that the interaction between social capital and entrepreneurship is controlled, are tested by multiple regression analyses and they are summarized in Table 4 and Table 5. The positive and statistically significant coefficients of human capital at a level of 0.05 in all models are consistent with the models mentioned by many researchers and indicate that a country's innovation is positively related to the human capital. A measure of R&D expenditure in all models is also positive and statistically significant at a level of 0.05 and indicates that a country's innovation is positively related to the investment in R&D.

However, the impacts of entrepreneurship and social capital on innovation are different from those of human capital and R&D expenditure on innovation. Entrepreneurship is statistically significant in the Model (2) and is also significant in Model (5) with interaction term at a level of 0.05. In Model (2), the variable, associational activity is also significant when we control the interaction between entrepreneurship and associational activity. But, the impacts of entrepreneurship and social capital on innovation in Model (3) and Model (4) are not significant at a level of 0.05.

[2] By factor analysis using each construct of human capital and social capital, this study found that education index, life expectancy index, and standard of living index are included in human capital factor and trust, associational activity, and civic norms are included in social capital factor.

Table 4 Regression Estimates for the Model of Innovation: Un-weighted values of Social Capital Index and Its Sub-constructs

Variables	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)	
Human Capital	0.3628***	0.3676***	0.3512***	0.4188***	0.3360***	0.3105***	0.2477**	0.3189**	0.3325***	0.3072***
R&D Expenditure	0.4586***	0.4837***	0.4954***	0.4877***	0.4245***	0.4338***	0.4114***	0.3747***	0.4242***	0.4240***
Entrepreneurship	0.2835**	0.5453*	0.2576**	0.3346***	0.1271	0.4839	0.2197	0.8522*	0.2340	0.8769**
Trust (UT)	-0.0016	0.1700					- 0.1071	- 0.0773		
Associational Activity (UM)			0.0410	0.3595**			0.0416	0.3506*		
Civic Norms (UC)					0.2382*	0.4081*	0.2502*	0.5431		
Social Capital Index (SCI 1)									0.0930	0.5094**
Entrepreneurship* Trust		- 0.4083						0.1522		
Entrepreneurship* Associational Activity				- 0.3426**				- 0.2447		
Entrepreneurship* Civic Norms						- 0.5126		- 1.0371		
Entrepreneurship* Social Capital Index										- 1.0234*
Total Population	0.6786***	0.6533***	0.7172***	0.7077***	0.6905***	0.6765***	0.7714***	0.7123***	0.7220***	0.6641***
Unemployment Rate	0.0278	0.0332	0.0364	0.0433	0.0194	0.0133	0.0409	0.0472	0.0426	0.0411
Income Inequality	0.0231	0.0423	0.0084	0.0137	0.0586	0.0572	- 0.0570	- 0.0461	- 0.0109	0.0046
The 5th Wave	- 0.0571	- 0.0585	- 0.0616	- 0.0143	- 0.0461	- 0.0430	- 0.0135	0.0989	- 0.0405	- 0.0174
Adjusted R^2	0.8637	0.8633	0.8661	0.8766	0.8719	0.8721	0.8701	0.8751	0.8643	0.8738
F-value	42.19***	37.48***	40.60***	39.68***	43.54***	38.89***	31.13***	25.25***	36.84***	35.61***
Countries	53	53	50	50	51	51	46	46	46	46

* Significance at 10%, ** significance at 5%, *** significance at 1%, two-tailed tests.

Coefficients are standardized beta weights.

Table 5 Regression Estimates for the Model of Innovation: Weighted values of Social Capital Index and Its Sub-constructs

Variables	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)	
Human Capital	0.3828***	0.4094***	0.3664***	0.4089***	0.3282***	0.2941***	0.2482*	0.2666*	0.3460***	0.3154***
R&D Expenditure	0.4534***	0.4870***	0.4926***	0.4899***	0.4054***	0.4128***	0.3906***	0.3217***	0.3910***	0.3841***
Entrepreneurship	0.2601**	0.8090*	0.2489**	0.3361***	0.1144	0.4289	0.1907	0.5309	0.1756	0.8937**
Trust (WT)	0.0272	0.2671					- 0.0764	- 0.1769		
Associational Activity (WM)			0.0727	0.2916*			0.0517	0.2937*		
Civic Norms (WC)					0.2788**	0.5002**	0.2772*	0.8195*		
Social Capital Index (SCI 2)									0.1780	0.6315***
Entrepreneurship* Trust		- 0.7319						0.6676		
Entrepreneurship* Associational Activity				- 0.2715*				- 0.1520		
Entrepreneurship* Civic Norms						- 0.5149		- 1.3932		
Entrepreneurship* Social Capital Index										- 1.1304**
Total Population	0.6709***	0.6346***	0.7145***	0.7142***	0.7034***	0.6881***	0.7754***	0.7119***	0.7205***	0.6632***
Unemployment Rate	0.0294	0.0402	0.0405	0.0440	0.0302	0.0260	0.0504	0.0555	0.0521	0.0573
Income Inequality	0.0320	0.0591	0.0092	0.0112	0.0479	0.0453	- 0.0530	- 0.0700	- 0.0114	- 0.0085
The 5th Wave	- 0.0585	- 0.0567	- 0.0341	- 0.0337	- 0.0529	- 0.0492	- 0.0145	0.1147	- 0.0276	0.0041
Adjusted R^2	0.8641	0.8655	0.8672	0.8747	0.8746	0.8764	0.8710	0.8797	0.8693	0.8828
F-value	42.33***	38.19***	40.99***	39.00***	44.58***	40.39***	31.38***	26.31***	38.42***	38.66***
Countries	53	53	50	50	51	51	46	46	46	46

* Significance at 10%, ** significance at 5%, *** significance at 1%, two-tailed tests.

Coefficients are standardized beta weights.

But, the impacts of entrepreneurship and social capital index on innovation are positive and statistically significant at the 0.05 level when we control the interaction between social capital and entrepreneurship in Model (5). Thus, this result on social capital index is consistent with the models mentioned by social capital theorists, such as Coleman (1988, 1990), Putnam (1993a), Knack and Keefer (1997), and Onyx and Bullen (2000) and suggests that a higher level of social capital is positively related to higher level of innovation. Model (5) with interaction term also shows that the impact of entrepreneurship is positive and statistically significant at a level of 0.05.

The results in this paper suggest that the overall level of social capital, consisting of trust, (passive and active) membership, and norms of civic behavior across all individuals within a country have a positive influence on overall innovation of the country. These findings support the argument that constructs of social capital, widely used in previous studies, constitute a set of coherent indicators and work in a similar way, which is not the same result as some previous empirical studies suggest (Portes, 1998; Woolcock, 1998; Dakhli and de Clercq, 2004). In particular, Dakhli and de Clercq (2004) fail to produce good proxies for social capital which are used widely in previous theoretical studies. Therefore, they suggest that previous theoretical proxies for social capital do not necessarily constitute a set of coherent indicators as well as those proxies may not work in the same way.

However, social capital index relating to the overall level of social capital of each country in this paper is positively related with innovation when we control the interaction between entrepreneurship and social capital. In addition, the reason why some results of this paper are different from previous empirical studies may be that the data, time period, model and constructs in this study are different from those of the previous studies. Although the results of this paper are different from those of several prior studies, the results are still in line with many other previous theoretical and empirical studies (Nichols, 1996; Knack and Keefer, 1997; Paxton, 1999; Putnam, 2000; Beugelsdijk and van Schaik, 2005) which discuss social capital at the international level, as this paper's regression analyses show positive relationship between social capital and innovation at the international level.

5. Conclusion and Implications for Future Research

This paper adds to the literature social capital and innovation by focusing on the international level, creating a more comprehensive measure of social capital and using a more general model of innovation. This study finds that social capital consisting of trust, (passive and active) membership, and norms of civic behavior across all individuals within a country have a positive influence on overall innovation. Considering that the previous public policy debate to generate innovation generally focuses on promoting investments in human capital and R&D, this study implies that public policy is also needed to consider instruments that would increase investments in social capital and entrepreneurship. Finally, the sample used in this study (about 50 countries) is limited by data considerations and might not be enough to describe the relationship between social capital and innovation at the international level. Future studies should try to increase the sample size.

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APPENDIX: Social Capital Index and Its Core Constructs of Each Country

ID	Country	UT	WT	UM	WM	UC	WC	SCI 1	SCI 2	SCI 3	SCI 4
1	Albania	41.56	48.42	10.06	9.29	56.34	43.40	35.99	33.39	33.70	31.26
2	Algeria	36.18	46.17	7.62	7.88	57.76	45.86	33.85	31.23	33.30	30.76
3	Andorra	-	-	2.31	2.00	-	-	-	-	-	-
4	Argentina	31.42	37.23	1.42	1.15	57.69	45.81	30.18	27.30	28.06	25.37
5	Australia	54.71	57.31	2.62	2.25	89.50	88.90	48.94	44.31	49.49	44.76
6	Austria	47.12	52.41	9.03	7.02	88.18	87.71	48.11	44.20	49.04	44.84
7	Bangladesh	50.27	60.98	21.79	21.12	57.75	41.45	43.27	41.12	41.18	39.18
8	Belarus	49.43	52.44	4.04	3.27	48.81	39.69	34.10	31.09	31.80	28.95
9	Belgium	43.85	49.11	9.35	7.49	-	-	-	-	-	-
10	Bosnia and Herzegovina	36.77	45.16	4.01	3.52	61.20	48.32	33.99	30.99	32.33	29.45
11	Brazil	33.99	43.91	2.28	2.08	58.31	49.78	31.53	28.60	31.92	28.94
12	Bulgaria	39.62	46.67	0.32	0.27	64.15	54.49	34.70	31.26	33.81	30.45
13	Burkina Faso	39.14	48.91	1.49	1.27	59.29	49.17	33.30	30.12	33.12	29.93
14	Canada	50.63	55.37	12.06	10.32	-	-	-	-	-	-
15	Chile	35.26	44.40	1.95	1.61	76.89	75.33	38.03	34.42	40.45	36.56
16	China	64.48	69.36	0.96	0.78	60.22	48.93	41.89	37.79	39.69	35.80
17	Columbia	35.25	43.55	1.17	1.02	-	-	-	-	-	-
18	Croatia	37.81	45.58	4.67	4.01	61.24	50.34	34.57	31.58	33.31	30.38
19	Cyprus	38.86	49.29	1.30	1.10	72.75	66.45	37.64	34.01	38.95	35.16
20	Czech Republic	38.29	44.04	6.04	5.13	64.91	56.15	36.41	33.38	35.11	32.11
21	Denmark	65.57	65.20	11.71	8.86	94.63	94.78	57.30	52.74	56.28	51.53
22	Egypt	55.25	62.19	-	-	64.21	52.13	-	-	-	-
23	El Salvador	-	-	-	-	65.88	56.33	-	-	-	-
24	Estonia	39.36	45.98	3.22	2.75	73.25	69.55	38.61	35.07	39.43	35.76
25	Ethiopia	39.07	44.94	3.23	2.63	57.18	43.11	33.16	30.17	30.22	27.46
26	Finland	63.68	65.63	2.49	1.97	92.88	94.13	53.02	47.96	53.91	48.72
27	France	39.56	47.90	1.47	1.30	78.74	77.24	39.92	36.07	42.15	38.06
28	Germany	45.52	50.09	1.39	1.19	85.83	84.30	44.24	39.96	45.19	40.79
29	Ghana	38.44	50.41	3.68	3.21	61.99	51.19	34.70	31.60	34.94	31.76
30	Great Britain	45.26	51.21	2.57	2.29	87.44	86.86	45.09	40.84	46.79	42.34
31	Greece	37.96	43.66	9.26	8.52	60.80	53.68	36.01	33.33	35.28	32.61
32	Hong Kong	53.59	58.58	-	-	85.81	84.69	-	-	-	-
33	Hungary	38.64	45.37	3.18	2.77	69.18	61.51	37.00	33.62	36.55	33.17
34	Iceland	52.91	57.63	16.54	11.63	94.75	95.65	54.73	50.91	54.97	50.64
35	India	48.77	58.96	4.84	3.64	54.33	44.20	35.98	32.87	35.60	32.40
36	Indonesia	53.30	57.62	2.88	2.51	57.70	43.42	37.96	34.45	34.52	31.32
37	Iran	36.27	46.53	1.71	1.46	56.98	45.79	31.65	28.66	31.26	28.28
38	Ireland	50.08	55.80	7.13	5.96	82.52	79.11	46.58	42.63	46.96	42.86
39	Italy	44.62	50.78	1.55	1.31	71.01	62.61	39.06	35.31	38.23	34.54
40	Japan	50.29	54.77	1.05	0.91	83.21	79.13	44.85	40.47	44.94	40.53
41	Jordan	54.60	63.92	-	-	74.38	67.43	-	-	-	-
42	Kyrgyzstan	36.51	44.44	3.90	3.05	53.65	41.39	31.35	28.61	29.62	26.97
43	Latvia	36.95	44.89	3.15	2.84	65.73	56.24	35.28	32.06	34.66	31.47
44	Lithuania	40.84	47.22	1.66	1.56	64.51	57.91	35.67	32.27	35.56	32.16
45	Luxembourg	45.16	52.82	8.56	7.11	84.19	84.51	45.97	42.23	48.15	44.05

46	Macedonia. Republic of	31.91	39.28	6.87	6.23	57.56	45.34	32.12	29.59	30.28	27.88
47	Malaysia	40.01	52.49	1.71	1.40	62.37	57.82	34.70	31.40	37.24	33.66
48	Mali	44.32	55.05	3.70	3.20	53.43	43.66	33.82	30.81	33.97	30.89
49	Malta	41.72	50.13	5.13	4.74	81.32	75.19	42.72	38.96	43.35	39.49
50	Mexico	35.30	43.18	2.60	2.32	55.68	47.41	31.19	28.33	30.97	28.10
51	Morocco	38.12	48.17	0.54	0.46	61.85	49.91	33.50	30.21	32.85	29.61
52	Netherlands	50.88	53.43	2.09	1.85	88.95	87.77	47.30	42.78	47.68	43.10
53	New Zealand	55.98	57.89	2.96	2.57	93.77	94.66	50.90	46.11	51.71	46.80
54	Nigeria	45.62	53.63	-	-	54.25	40.15	-	-	-	-
55	Northern Ireland	49.30	53.22	5.13	4.08	-	-	-	-	-	-
56	Pakistan	48.07	54.97	-	-	59.05	43.83	-	-	-	-
57	Peru	30.45	38.35	7.57	7.10	59.93	49.96	32.65	30.14	31.80	29.33
58	Philippines	38.98	51.21	8.95	8.86	50.70	40.42	32.88	30.48	33.50	31.03
59	Poland	37.92	45.29	1.03	0.84	61.13	50.28	33.36	30.13	32.14	29.01
60	Portugal	37.32	48.24	2.12	1.85	77.08	72.25	38.84	35.17	40.78	36.89
61	Puerto Rico	41.58	49.18	9.51	8.68	-	-	-	-	-	-
62	Republic of Korea	45.79	52.02	1.61	1.28	69.15	61.49	38.85	35.12	38.27	34.57
63	Republic of Moldova	34.55	41.22	1.30	1.08	54.12	44.07	29.99	27.12	28.79	26.02
64	Romania	38.59	45.91	0.34	0.31	60.18	48.11	33.04	29.77	31.44	28.33
65	Russia	42.22	48.43	0.72	0.55	52.78	41.27	31.91	28.79	30.08	27.13
66	Rwanda	-	-	2.94	2.56	59.02	47.81	-	-	-	-
67	Serbia and Montenegro	33.44	40.70	0.81	0.62	45.88	38.73	26.71	24.12	26.68	24.07
68	Singapore	-	-	5.51	4.74	91.25	92.35	-	-	-	-
69	Slovakia	38.01	46.93	7.43	6.84	63.17	55.10	36.20	33.32	36.29	33.35
70	Slovenia	35.67	42.69	1.61	1.39	72.45	67.87	36.58	33.08	37.32	33.72
71	South Africa	41.45	51.03	3.01	2.48	64.89	56.93	36.45	33.10	36.82	33.38
72	Spain	39.97	47.99	0.91	0.78	78.98	75.39	39.95	36.05	41.39	37.33
73	Sweden	65.78	64.89	2.60	2.05	89.94	90.76	52.77	47.75	52.57	47.52
74	Switzerland	57.48	60.03	2.82	2.44	91.81	91.48	50.70	45.92	51.32	46.43
75	Taiwan	38.53	44.26	1.11	0.90	74.39	68.23	38.01	34.32	37.80	34.11
76	Tanzania	43.05	57.03	28.21	27.97	61.80	48.68	44.35	42.74	44.56	42.90
77	Thailand	50.75	54.45	2.06	1.76	57.72	49.83	36.84	33.36	35.35	31.99
78	Trinidad and Tobago	28.89	38.93	2.73	2.32	61.96	52.38	31.19	28.35	31.21	28.32
79	Turkey	35.33	47.54	0.26	0.23	64.88	52.93	33.49	30.17	33.57	30.23
80	Uganda	39.92	52.85	14.28	13.63	54.65	42.79	36.28	34.08	36.42	34.14
81	Ukraine	42.44	48.09	0.80	0.63	51.98	41.59	31.74	28.64	30.10	27.16
82	United States	50.46	54.81	3.02	2.61	82.79	80.08	45.43	41.19	45.83	41.51
83	Venezuela	36.74	45.08	-	-	54.90	42.14	-	-	-	-
84	Vietnam	70.78	78.25	1.39	1.29	58.52	45.51	43.56	39.34	41.68	37.65
85	Zambia	36.00	45.80	3.79	3.25	50.89	40.93	30.22	27.58	29.99	27.32
86	Zimbabwe	39.49	50.53	11.31	10.37	60.56	46.74	37.12	34.54	35.88	33.33