Digital Dividends

Development Impact of Social Media

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Background paper prepared for the

World Development Report 2016: Internet for Development

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25 July 2015

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1 Introduction

This paper assesses the role of social media in social and economic development. The web and in particular, social media such as social network sites (e.g. Facebook) and microblogs (e.g. Twitter), allows ordinary citizens to connect with one another and share information via computer-mediated networks. This behaviour is often explicitly or implicitly networked (for example, people 'friend' one another on Facebook and 'follow' one another on Twitter, leading to the formation of social and information-sharing networks). For that reason, we use an analytical framework that draws from the extensive literature on social networks. We summarize research on social networks, social learning and development and use this as a basis for assessing the potential impact of social media on social and economic development.

There is no doubt that the advent of the web (which is not even 25 years old), and more recently social media, has had a huge impact on how people communicate with one another and access (and produce) information. However, for several reasons, it is difficult to draw definitive conclusions about the impact of social media on social and economic development at a global level. First, there is the obvious point that social media requires telecommunications infrastructure and education levels such that it is often only used by the relatively well-off in developing countries and there will be urban/rural disparities in social media use. Second, there is not a lot of academic evidence on the impact of social media in developing countries and where it has been shown that social media has a positive impact on economic outcomes, this has been for specific groups in society (e.g. business owners, middle class women in secondary-earner roles). The generalizability of these findings to other groups in society, and hence assessment of overall impact of social media, is not certain. Finally, the impact of social media on social and economic development within a given country will be

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influenced by government policies (e.g. towards telecommunications infrastructure, education, censorship) and also the cultural setting of the country.

The structure of the paper is as follows. Section 2 provides a definition of social media and a summary of research findings on international patterns of social media use. Section 3 looks at how social networks impact on technology adoption and aspirational change (via social learning). The section summarizes economic perspectives on social learning but also covers social networks concepts from other disciplines (primarily sociology) such as weak/strong ties, structural holes and social capital, that are relevant for evaluating the impact of social media on social and economic development. The next three sections summarize social media research relating to particular topics: economic activity (Section 4), emergencies (Section 5) and community voice (Section 6). Section 7 provides conclusions.

2 Social media – overview

This section provides a definition of social media and identifies the subset of social media that is the focus of this study. There is also a summary of cross-country data on social media use. Note that in this section, we use some social networks concepts and terminology which are formally introduced in the Annex.

2.1 Definition of social media

The web is commonly understood to have had three overlapping phases of development or eras, Web 1.0, Web 2.0 and Web 3.0. Under Web 1.0, webmasters create content that is then read or consumed by users, while Web 2.0 allows the blurring of the distinction between users and webmasters, with blogging tools, social network sites (e.g. Facebook) and microblog services (e.g. Twitter) enabling non-technical people to both produce and consume web

content (this is referred to as 'prosumption' (Ritzer and Jurgenson, 2010) and 'produsage' (Bruns, 2008)). Web 3.0, or the Semantic Web, involves technologies that make the web more machine-readable, leading to a 'web of data', which is an evolution of the Web 1.0 'web of documents' (Shadbolt et al., 2006).

We define social media as web platforms that enable users to create, share, and exchange their ideas, content, information, videos or photos in computer-mediated groups and communities. In this paper we focus on two main examples of social media: social network sites, and microblog sites. Social network sites (SNS) are defined as "web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within system" (Boyd and Ellison, 2008, p. 211).[1] The best-known social network site is Facebook, but other prominent examples are LinkedIn (for professional networking) and Renren in China.

Microblogs allow subscribers to broadcast short messages to other subscribers of the service. The best-known microblog is Twitter, where the short messages are called "tweets" and are limited to 140 characters. Sina Weibo is a prominent example of a Chinese microblog (in China, both microblog services and the short messages are called "weibos").

This paper is focused on social network sites and microblogs since – due to their relatively widespread use and also their functionality – these prominent examples of social media are most likely to be relevant to social and economic development. However, it is important to note that social media encompasses other types of computer-mediated interaction such as wikis, folksonomies or social tagging sites, mashups and instant messenger services (Beer 2008; Kietzmann et al., 2011, p. 519).

The typology of online networks proposed by Ackland and Zhu (2015) helps to further distinguish the different types of social media studied in the present paper. The authors identify two dimensions of ties in online networks: *directionality* refers to whether a tie between any pair of nodes is directed versus undirected, while *manifestation* refers to the substantiality of the relations between nodes, with active acts (e.g., invitation, acceptance) leading to explicit ties, while implicit ties are more inferred (e.g., co-occurrence or interactions). The typology leads to four categories or types of online networks (Table 1). Explicitly undirected ties lead to networks which are the closest to the classic notion of social networks, i.e., friendships that require mutual consent to establish (Facebook is an example). Explicitly directed ties involve a one-way, public (or broadcast) mode of relations among users (Twitter is an example). Implicitly undirected ties are in some ways 'hidden' or 'invisible' connections, in that they are constructed or inferred by social network analysts *post hoc*, based on semantic similarity (e.g., co-usage or co-occurrence of keywords or tags) between pairs of nodes (the Flickr photo tagging site is an example). Finally, implicitly directed ties can be extracted from the interactions of people in newsgroups or blogs (the hyperlinks between web pages on the WWW are also examples); these ties are implicit because while a person might reply or respond to another person in a newsgroup, such "opinion exchanges" are really only indirect or inferred connections between the people.

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[1] This definition has been criticized by Beer (2008) since it is similar to the concept of Web 2.0 or user-generated content in terms of its broadness.

Table 1: Direction and manifestation of ties in online networks (from Ackland and Zhu, 2015)

		Direction of ties	
		Undirected	Directed
Manifestation of ties	Explicit	Friendship networks (e.g. Facebook, Google+)	Microblog networks (e.g. Twitter, Sina Weibo)
	Implicit	Semantic networks (e.g. recommendation systems, social tagging systems)	Threaded conversation & hyperlink networks (e.g. newsgroups, blogs, WWW hyperlink networks)

2.2 International patterns in social media use

In this sub-section, we present evidence on general trends of social media use and differences by age, gender and nationality, using publicly available statistics and research.

First, we look at prevalence of social media use in different countries. The Pew Research Center surveyed adults in 21 countries (including developing countries) about their use of social media (Kohut et al., 2012).[2] The percentage of people reporting they use the internet varied from a high of 85 percent in Britain to a low of 6 percent in Pakistan. At a country level, there is a negative relationship between internet use and the propensity to use social media (Figure 1). This is due to the fact that in richer countries a relatively wider range of

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[2] While the Pew report refers to "social networking sites" in fact it collected data on usage of sites other than what we have defined above as "social network sites" (e.g. Facebook), and hence we refer to the Pew report in the context of "social media" usage. The surveys listed country-specific examples of social media sites. For example, US participants were asked about their use of sites such as Facebook and Myspace, while in Britain the list included Facebook, Twitter, YouTube and Flickr and the list for China included Facebook, Renren, MySpace, and Weibo (a generic term for microblogging).

socio-demographic groups have access to the internet; specifically, older people are more likely to be using the internet, and older people are much less likely to use social media. In contrast, in lower-income countries internet use is more common among more professional (and younger) people, who are more likely to be active on social media.
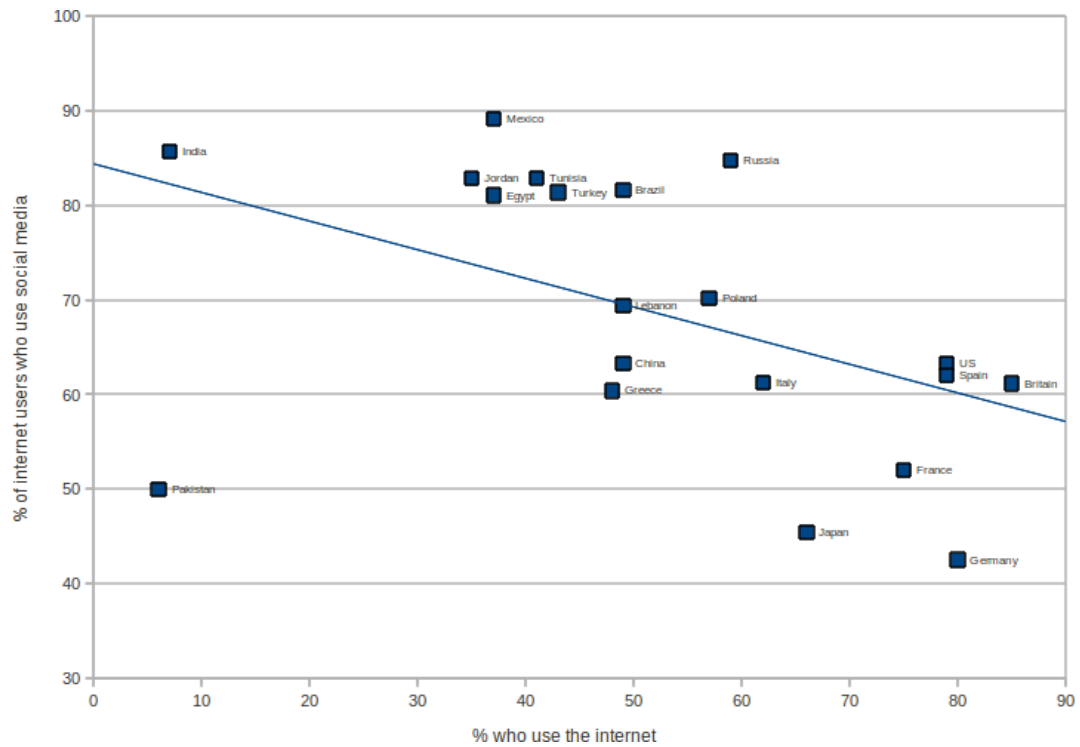
Figure 1: Percentage of internet users who use social media, by internet use

Source: Author calculations based on data from Kohut et al. (2012)

Figure 1 shows that in all but three countries, a majority of the people who use the internet also use social media, leading the Pew report authors to comment that "Social networking has spread around the world with remarkable speed" (p.1). The usage of social media in Pakistan is much lower than would be expected (given the percentage of the population who use the internet) and among the richer countries, social media use is relatively lower in Germany and Japan. Among the middle-income countries it appears that Mexico and Russia might have a relatively higher propensity to use social media.

It has been noted that many Facebook users in developing countries are not aware that they are using the internet (http://qz.com/333313/millions-of-facebook-users-have-no-idea-theyre-using-the-internet/). This situation comes about because Facebook Corporation, via its internet.org initiative, seeks to ensure that Facebook is an easy and accessible application on mobile phones in developing countries, with users requiring a data plan in order to access other sites on the WWW. While the development implications of this are unclear, this does mean that some users are effectively constrained to accessing information and services under the Facebook corporate umbrella, rather than the open web.

Box 1: Many Facebook users do not know they are using the internet

Next, to what extent do individuals access social media? Ofcom (2013) (Figure 5.26) indicates that among the surveyed countries in 2013, a majority of internet users accessed social media at least once a week. Spain has the highest access rate, with 72 percent of internet accessing social media at least once a week, while Japanese users are least likely to access social media (45 percent). Also, in the U.K., Italy, Australia and China, over 60 percent of internet users

accessed social media weekly. Around 50 percent of respondents from the rest of countries such as France, Germany and the U.S. had accessed social media at least once a week.

Different social media platforms are used in different countries. While Facebook is the most popular social media service in the world, its popularity varies across countries. For example, Facebook is remarkably dominant in Indonesia with 95.7 percent of survey respondents having used the application, according to data compiled by Winkels et al. (2013). However Facebook use in other Asian countries such as China, South Korea and Japan, is not as high as Indonesia or India. Since Western social media such as Facebook, Twitter and Google+ is blocked by the Chinese government, Chinese indigenous social media such as Qzone and Sina Weibo are more popular among the Chinese. There are other examples of popular indigenous social media such as KakaoStory in South Korea and Mixi in Japan, respectively. These services seem to play a role in limiting the popularity of Facebook in these countries, and this phenomenon is also seen outside of Asia. Facebook is not the dominant social media platform in Russia, for example, where homegrown social networking sites VKontakte and Odnoklassniki.ru are more popular than Western social media.

2.3 Cultural differences in social media use

People living in different places behave differently, and this is reflected in social media use. For instance, Poblete et al. (2011) found that Twitter users in Indonesia tend to make many more connections (not only with friends and family, but also acquaintances), compared with Twitter users in Australia. Yanai et al. (2009) identified cross-country differences in photo sharing behavior on Flickr, finding that shared photos of wedding cakes in the U.S. are taller than those in Europe.

Where do such differences in social media use come from? Hofstede's work on "cultural dimensions" (Hofstede, 1980), despite being widely criticized (Ailon, 2008), has been influential in recent computer science research into cultural differences in social media use. Analyzing survey data on IBM employees around the world, Hofstede identified five cultural dimensions: 1) power distance, 2) individualism vs. collectivism, 3) masculinity vs. femininity, 4) long-term orientation vs. short term orientation, and 5) indulgence vs. restraint. The literature on social media use has tended to highlight two of the dimensions, namely, power distance and individualism vs. collectivism. Power distance reflects "the degree of acceptance of inequality between a boss and a subordinate" (Ailon, 2008, p. 889), that is, it is a measure of the extent to which the less powerful members of a society accept that power is distributed unequally. Individualism vs. collectivism is defined as "the relationship between the individual and the collectivity which prevails in a given society" (Hofstede, 1980, p. 213), and gives a measure of the extent to which a society encourages individuality and uniqueness versus conformity and interdependence.

Garcia-Gavilanes et al. (2013) collected data on Twitter users from 30 countries for 10 weeks. The authors found that in countries that are more comfortable or accepting that power is distributed unequally (i.e., there exists significant power distance), there is more likely to be connections on Twitter between pairs of users with markedly different levels of popularity (i.e., the number of followers). In contrast, people in countries with low power distance (i.e., have the expectation that power is or should be equally distributed among citizens) are less likely to make connections with those who have significantly more or less followers. The authors also found a significant negative correlation between the number of tweets that include mentions of other Twitter users and the Tweet author's measure of individualism (based on their country of origin). This suggests that Twitter users from cultures with a higher

level of collectivism are more inclined to mention other users in their tweets (and supports the above finding regarding differences between Indonesia and Australia).

Gao et al. (2012) compared the behavior of Twitter and Sina Weibo users, and given that more than 80 percent of the Twitter users in their sample were (according to their profiles) from the U.S., while more than 95 percent of the Sina Weibo users were located in China, the authors contend that their study in fact comprised a U.S.-Chinese comparison. They found that Twitter users retweet more quickly than their Sina Weibo counterparts, and that information propagates more quickly on Twitter compared with Sina Weibo. The authors contend that this reflects differences in power distance between the two countries (U.S. microbloggers act as if they have the power to propagate information and thus potentially challenge existing hierarchies).

Recent survey data also indicates marked cross-country variation in how people use social media. The surveys conducted by the Pew Research Center showed that Arabic users tend to access social media in order to express their political views, whereas users in Western countries are more likely to share recreational content such as photos, music, movies, and sports (Kohut et al., 2012).

3 Social networks and social learning

This section defines **social learning**, which we then use as a framework for assessing the potential impact of social media on social and economic development.[3]

Technology adoption refers to households and individuals deciding whether to adopt technologies that can improve productivity and well-being. The process involves actors

learning about an underlying state of the world (for example, the usefulness of a new technology or practice related to farming, or a health innovation) and as a result, changing their behavior (adopting the technology). Under what conditions will this occur, and importantly, under what conditions will the actors make the correct decision e.g. adopt a technology or behavior that will improve their circumstances (and that of society as a whole)?

The role of social interactions in technology adoption in poor rural communities has been studied by authors such as Duflo et al. (2009) in the context of adoption of fertilizer in Kenya, and Kremer and Miguel (2007) in the context of de-worming drugs (also in Kenya).

The other aspect of economic development that we consider in this section is **aspirational change**, which refers to the process whereby poor households become more "future-oriented" in their thinking (Appadurai, 2004; Ray, 2006), leading to investments in education and productive capacity. Ray (2006) introduces the concept of the "aspiration window" and argues that more expansive future-oriented behavior (a widening window) can result from an individual's social interaction with peers and near-peers. Macours and Vakis (2009) found evidence of improvement in aspirations of people randomly connected to women in leadership positions in their community.

We refer to the above as **economic aspirational change** since it refers to changing aspirations that are likely to impact on the economic well-being of a household. However in this paper, we are also concerned with the potential impact of social media on social development more broadly and so we can also define **political aspirational change** as referring to changing aspirations relating to the political situation within a community or country.

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[3] There is a lot of research on social learning in the formal education context, however this is not the focus of the present paper. For a study of social media and social learning in formal education, see Yu et al. (2010) and references within.

3.1 Social learning – introduction

Social learning has been studied from various disciplinary perspectives; this sub-section provides a brief introduction to economic and other perspectives on social learning.

3.1.1 Perspective from economics

Economists distinguish between two types of social learning.[4] **Observational learning** is where agents learn by observing the past behavior of others (e.g. which product was bought, which restaurant people went to). With observational learning, agents update their beliefs (their initial private signal about the state of the world) by observing past actions. The problem with observational learning is that agents may not act on their beliefs (that is, their private signal tells them to not purchase the product because it is a "lemon", but they go ahead anyway).[5] This can result in "herd behavior" (whereby individuals follow a pattern of behavior regardless of their signal or belief) or "informational cascades" (Bikhchandani et al., 1992; Banerjee, 1992). Herding can occur because the success of a product creates a "tipping point", inducing others to purchase the product even if their private signal or belief says otherwise.

Society is said to be "wise" if consensus leads to individuals learning the correct underlying state. While herding involves consensus, it leads to the wrong outcome because there is not an efficient aggregation of information. There exists an "informational externality" in that agents do not take account of the information they reveal to others, by their actions.

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[4] This section draws on Acemoglu and Ozdaglar (2009).
[5] Agents may also ignore their private signal for selfish reasons e.g. purchasing a stock in a dud company in order to ramp up the price. This amounts to the agent not revealing (through action) the private signal.

Online rating and recommendation systems facilitate observational learning since they enable people to observe (at an aggregate level) how other people are consuming or engaging with goods and services. Do these online systems have an impact on the likelihood that scieties will be wise (the consensus gained via observational learning is "correct")? Do these systems increase the likelihood of selfish behavior whereby agents do not reveal their private signal, in order to gain market advantage? A form of misinformation in social media is "astro-turfing", whereby groups or organizations with an interest in a product, service or message attempt to manufacture the appearance of grassroots support, by, for example, posting fake reviews or comments in social media.

Box 2: Observational learning

Observational learning is most relevant for markets, where an agent infers the beliefs of other agents by observing their market behavior (e.g. whether they purchase the product or not). The other type of social learning involves agents not only learning by observation but also directly communicating their beliefs to one another (via social networks), known as **communication learning**.

Acemoglu and Ozdaglar (2009) present a model of myopic learning, whereby agents update their beliefs by averaging their neighbour's beliefs (where an agent's neighbours are defined as the set of people who this person listens to, or trusts).[6] In the myopic learning model, society will only be wise if no one agent has their opinion listened to more than they listen to other people's opinions (this can be seen as a measure of influence in a social network). Thus, in the presence of one or more influential agents, the myopic learning model does not lead to "asymptotic learning" (society becoming wise as the number of people grows) – the information of influential agents is over-represented.

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[6] This model was introduced by DeGroot (1974). See also Golub and Jackson (2010).

Golub and Jackson (2010) examine social learning under various assumptions regarding network structure and show that there can be asymptotic learning under a reasonably wide range of networks. They focus on the role of prominent actors and groups of actors and show, for example, if there is an agent whose degree (the total number of people in the network who trust this person) is a non-vanishing fraction of total sum of links (the total number of trust "nominations" made in the network) as the network grows, then a wise society will not obtain in the limit.

Social network sites and microblogs facilitate communication learning since they enable the formation of communication networks via which people can share their beliefs and opinions, and potentially influence the behavior of others. Does the growing popularity of social network sites and microblogs have an impact on the likelihood that societies will be wise (i.e. consensus gained via communication learning is "correct")? Do these systems increase the likelihood of selfish behavior whereby agents do not reveal their private signal or deliberately mislead by communicating incorrect signals (an example of misinformation), in order to gain market advantage? How does social media impact on the prevalence or impact of influential actors in social networks? Does social media lead to social networks being reconfigured in a way that increases or decreases the chance that societies will be wise?

Box 3: Communication learning

3.1.2 Other perspectives

This section provides a brief overview of how social learning has been conceptualized in other disciplines (e.g. social psychology and sociology). The aim is to augment the economics

perspective presented above and identify other concepts that are useful in the context of understanding the impact of social media on social and economic development.[7]

Social learning can occur via two types of social interaction: information transmission and deliberation. Information transmission involves the learning of simple or straightforward facts (e.g. is this innovation useful?), and is the focus of the economist's perspective on social learning, presented above. Deliberation refers to a genuine exchange of ideas and arguments, where actors attempt to persuade others to change potentially deeply-ingrained attitudes and perceptions. The concept is linked to the work of Jürgen Habermas (1981) and in particular, his work on public sphere theory (Habermas, 1989) which refers to "social sites or arenas where meanings are articulated, distributed, and negotiated, as well as the collective body constituted by, and in this process".[8]

The process of deliberation is arguably not as important in context of economic development (where social learning involves relatively straightforward decisions as to whether to adopt a technology or practice or not) but it is highly relevant to social development, for example relating to social inclusion, policies towards minorities and opportunities for women in education. However, deliberation may also be relevant to economic development in situations where economic decisions require actors to challenge their beliefs - for example, a community's decision to adopt a more sustainable form of farming or adapt to climate change may first require deliberation as to whether environmental degradation or the climate are worth worrying about.

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[7] This section draws on Reed et al. (2010).
[8] http://en.wikipedia.org/wiki/Public_sphere

The Intergovernmental Panel on Climate Change (IPCC) defines climate change adaptation as "adjustment in natural or human systems in response to actual or expected climactic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (http://www.ipcc.ch/publications_and_data/ar4/wg2/en/annexessglossary-a-d.html). As noted by Henry (2010), climate change adaptation implies several learning challenges, involving the exchange of ideas and knowledge between different communities of knowledge and action: what will the climatic stimuli be, and how to design adaptation policies that will be effective, rather than doing more harm to the climate (i.e. avoiding perverse learning)? While not focused on social media, Henry (2010) provides useful insights into how social networks present opportunities for, and barriers to, climate change adaptation. For example, Henry (2010) contends that networks that promote successful coordination across sectors or scales are likely to promote successful learning, while networks that are heavily fragmented or exclude or shut out key information sources may hinder successful learning.

Box 4: Networks and climate change adaptation

Reed et al. (2010) emphasize three potential constraints to social learning: social norms, institutions, and network structures. Reed et al. (2010) also note that social learning is more likely to occur if groups with different types of knowledge share epistemological beliefs, and they also argue that power and scale can also impact on social learning.

3.2 Social networks and social learning

In this sub-section we explore further how social structure can impact on social learning. The work of economists featured prominently in the above summary of social learning, and economic models (Golub and Jackson, 2010) provide testable assumptions about the relationship between different social network formations and social learning. However, the

majority of the literature surveyed in the present section is from outside of economics (predominantly, sociology).

Social media may impact on the deliberative process, and hence social learning. Public sphere theory has been an inspiration for a large body of research on how the web is enabling the construction of new spaces for deliberation that are not constrained by geography or time (see, for example, Rogers (2010)'s work on issue networks). However the exact impact of the web on deliberation has been debated in the academic literature with early predictions ranging from the utopian to the dystopian. For example, Castells (1996) argued that the web would promote participatory democracy (broad participation in the direction and operation of the political system), while Putnam (2000) and Sunstein (2001) predicted increased isolation and the loss of a common political discourse. The latter phenomenon has been referred to as cyberbalkanisation (Van Alstyne and Brynjolfsson, 2005) a fragmenting of the online population into narrowly focused groups of individuals who share similar opinions and tend to be exposed to information that confirms their previously held opinions. It was noted above that power relations are important for social learning, and it is therefore pertinent to discuss the potential reconfiguring role of social media in this context. In particular, a body of research has considered whether the web (or ICTs more generally) may be "reconfiguring access" (Dutton, 2005) to scholarly information and expertise, hence altering the distribution of academic authority or prominence at the level of individual researchers, teams, universities and countries.

Box 5: Deliberation and social learning

3.2.1 Weak ties, structural holes and social capital

This sub-section provides a brief summary of three distinct but related strands in the social networks literature: weak and strong ties, structural holes and social capital.

The standard economic approach for understanding labour market experience (e.g. employment, wages earned, occupational attainment) focuses on personal characteristics ('human capital'), such as education, age, labour market experience, skills. In contrast, the network perspective regards the person's social network as the main driver of labour market success, since networks can provide opportunities (and also impose constraints) that impact on behavior and outcomes. In particular, Granovetter (1973) emphasizes the importance of **weak ties** (connections with people who are less socially engaged with one another in your network i.e. acquaintances) as potential sources of innovative and useful information in the context of labour market outcomes. Weak ties can be contrasted with **strong ties** (connections with people who are frequently involved with one another in your network i.e. close friends) – while strong ties can be a source of emotional support they are often considered redundant as sources of innovative information that might be useful in a labour market context (since your close friends are all likely to have the same information).

The principle that indirect social ties matter is also evident in Ronald Burt's work on **structural holes** - gaps or holes in the social structure of communication, which inhibit the flow of information between people and can present opportunities for strategic advantage in two ways (for a review, see Burt, 1992). First, people who bridge or span structural holes are exposed to varying opinions, behaviors and sources of information, and they may be able to combine this disparate knowledge in a way that provides productive advantage (this is referred to as **brokerage**). However, *not* spanning a structural hole (i.e. staying within a closed network where there is a high level of connectivity) may confer another important type of advantage: higher levels of trust and coordination can improve team effectiveness and efficiency by lowering labour and monitoring costs (this is referred to as **closure**).

The concepts of structural holes and strong/weak ties are illustrated in Figure 2.

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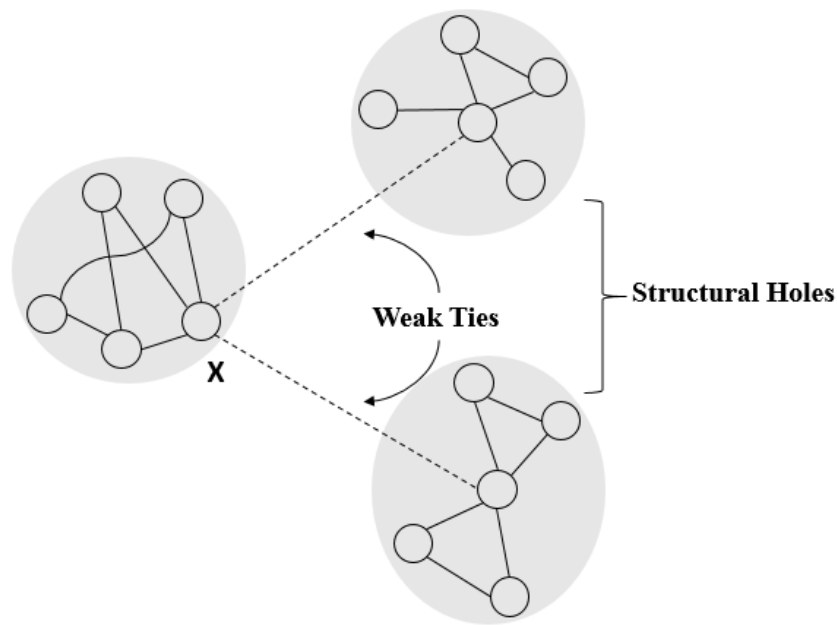
Figure 2: Structural holes and weak ties

Source: Adapted from Burt (1992)

Social capital is the concept that "a person's family, friends, and associates constitute an important asset" (Woolcock and Narayan, 2000). In general, two perspectives have been adopted in social capital research; namely, the communitarian and network perspectives. The communitarian perspective (Putnam, 1993) highlights horizontal associations and group-or community-level engagements. For instance, Putnam (1993) defines social capital as "features of social organization such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit" (p. 35). The network perspective, which is primarily identified with Nan Lin (Lin, 1999, 2001), involves identifying "resources embedded in social structure which are accessed and/or mobilized in purposive actions" (Lin, 1999, p. 35), and hence focuses on both "horizontal and vertical aspects of social connections" (Aldrich, 2012, p. 31).

Both perspectives use the concepts of **bonding** and **bridging** social capital. Bonding social capital refers to strong linkages between people who know each other well such as family members and close friends (i.e. strong ties), and can be a source of emotional and substantive support. Bridging social capital, in contrast, captures the idea that weaker connections between people who may barely know one another such as acquaintances (i.e. weak ties) can be a source novel information.

The concepts of bridging and bonding social capital are illustrated in Figure 3.
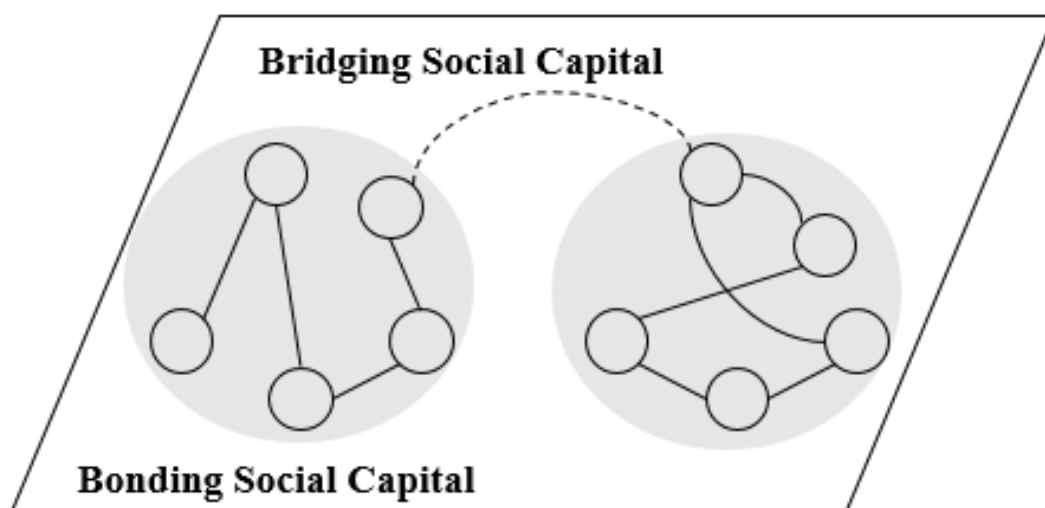

Figure 3: Bridging and bonding social capital

Source: Adapted from Aldrich (2012, p. 34)

3.2.2 Social learning and social media

The concepts of weak ties, structural holes and social capital provide frameworks for assessing the potential impact of social media on social learning in the context of social and economic development.

With technology adoption, weak ties are likely to be more effective in transmitting novel information about new technologies that can improve productive capacity. In the language of structural holes, actors who occupy structural holes are more likely to have the "vision advantage" that can allow them to innovate. This similarly points to the importance of bridging social capital, in this context. However, this argument is possibly more relevant to innovation in advanced economies where actors are competing with one another to gain competitive advantage. In a developing country setting, technology adoption can involve, for example, convincing farmers to adopt a technology or technique that is already known to be more effective (rather than finding a novel solution on their own). There is only mixed evidence that social learning can contribute to technology adoption in developing country settings. For example, Duflo et al. (2009) found no evidence that social learning contributed to the adoption of fertilizer in Kenya, despite its demonstrated profitability. This points to the fact that in the context of technology adoption in developing countries, strong ties might be more important for bringing about technology adoption since they are more likely to be a source of trust.

With regard to economic aspirational change, it can similarly be argued that strong ties are likely to be more important than weak ties, when it comes to widening the aspirational window. Ray (2006) contends that an individual will tend to form aspirations by observing other individuals with whom he or she can identify. Such individuals are more likely to be 'close' to the individual who is forming aspirations in the sense that they share attributes in common i.e. they are more likely to be strong ties.

Microblogs are traditionally considered platforms for developing weak ties while social network sites are considered more useful for developing and maintaining strong ties (note however that there are cultural differences in the use of social media, as discussed below). The above discussion suggests that in the developing country setting, strong ties are more likely to be important for facilitating technology adoption and economic aspirational change. So this would point to the potential role of SNSs such as Facebook. However, it is not clear that SNSs "in the wild" such as Facebook will be broadly useful for promoting development via technology adoption and economic aspirational change. There are the issues of infrastructure and the digital divide - will the households concerned have access to the internet and the requisite skills to be able to effectively use it? Setting the question of infrastructure and the digital divide aside, it may be that the most effective way for SNSs to be used for promoting development is via purpose-built SNS platforms which are rolled out as part of development interventions. The SNS could be used to form teams and groups, connecting aid recipients with leaders in an optimal way (where attributes are matched in a way that maximizes the chance of social learning). Thus social media applications such as Facebook may (at present) have limited use in achieving technology adoption and economic aspirational change in poor rural communities, but they could inform the development of purpose-built social media applications used in development interventions.

Box 6: Strong and weak ties, and social media

In the context of political aspirational change, Gibson (2001) argues that weak ties are effective in transmitting novel information about unfamiliar political institutions but also notes that weak ties might also transmit information which undermines democratic governance. Gibson (2001) also contends that in societies where democratic values and processes are not well understood (i.e. transitional regimes), weak ties can contribute to social learning in this context; in contrast weak ties may not contribute much (in this political context) in societies where political institutions and democratic values are already strong.

As discussed in Section 6 below, Howard et al. (2011) have suggested that Twitter contributed to the democratic progress during the so-called Arab Spring, thus supporting the view of Gibson (2001) regarding the role of weak ties. However Gladwell (2010) has downplayed the role of weak ties (and hence social media) in social unrest in the Arab Spring, arguing that democratic change can involves risk-taking behavior, which is best facilitated via strong ties. In the political unrest in Ukraine in 2014 participation in street protests was inherently risky and while Twitter did not seem to figure strongly, it has been suggested that Facebook was a primary communication and coordination tool used by the protesters (however Etling (2014, p.5) provides counter-evidence).

Box 7: Political protest in the Internet Age

There is a large body of research into the relationship between internet use and social capital. A motivating factor for this research was the suggestion (Putnam, 2000) that younger people have less social capital (measured by community volunteerism and trust in fellow citizens) than their parents did when they were young. Since younger people use the internet more than older people, this had led to the question whether internet use decreases social capital. McPherson et al. (2006) found that there had been a decline in the size of 'core networks' in the U.S. (people with whom the respondent can talk about 'important matters') and an increase in social isolation. These findings reignited panic about the negative effect of the internet on social connectivity, even though the authors and others (Fischer 2009; McPherson et al. 2009) noted that the results indicating a trend of increasing social isolation needed to be treated with caution.

Does social media impact on social capital or alter the formation or the mix of strong and weak ties? Can social media use lead to the diminishment of 'real world' strong or weak ties? The evidence in developed countries suggests that the internet and social media is unlikely to have had a negative impact on social capital formation. The real-world impacts of the internet are likely to be complex and hard to disentangle from other major forces, for example demographic and economic, that are affecting patterns of communication and community (Fischer, 1997). If one considers major forces impacting on poor communities throughout the world – process of urbanization, and migration - these are likely to have major impacts on social capital and the mix of strong/weak ties. An example is the migration of workers from poor rural areas to cities within their own country (for example the guest worker phenomenon in China) or other countries. This movement has a potentially huge impact on bonding social capital (since the person moves away from family and close friends, who are the source of emotional support) and bridging social capital (the person who has moved is no longer embedded in a social network that provides information and other resources). In both of these cases the internet and social media in particular can provide opportunities for maintaining and building both bridging and bonding social capital in the face of such disruption.

Box 8: Does social media reduce social capital?

3.3 Country-specific factors

This sub-section outlines some country-specific factors that are likely to affect how social media impacts on social and economic development.

3.3.1 The role of government

Government will have a major influence on how social media impacts on social and economic development in a particular country.

First, government allocates resources and develops policy relating to telecommunications and internet infrastructure. Factors such as the overall level of economic development and geography will of course have a large influence on the percentage of the population that are connected to the internet, but government policy will also be important.

The Web Index (http://thewebindex.org) is produced by the World Wide Web Foundation (http://www.webfoundation.org), which was established in 2009 by WWW inventor Sir Tim Berners-Lee to "promote his vision of an open Web which is available, usable, and valuable for everyone". The Web Index is a multi-dimensional measure of the contribution of the web to social, economic and political progress, and provides a ranking of countries (similar to UN's Human Development Index). Using a combination of secondary data and primary data (based on expert surveys), scores are given in four areas (sub indexes): universal access, freedom and openness, relevant content and empowerment. One of the secondary indicators in the 2014 Web Index in the "relevant content and empowerment" sub index was the number of monthly active users in the dominant social network site, divided by the population of the country. Also of relevance to the present report, the "freedom and openness" sub index assesses "the extent to which citizens enjoy rights to information, opinion, expression, safety and privacy online, and some aspects of Internet neutrality."

Box 9: The Web Index

Second, government policy will influence the extent to which the population has the education and digital literacy to benefit from access to the internet. Again, education levels and digital literacy will be largely dependent on overall economic development, but government policy will influence, for example, the extent to which all members of the population (for example both men and women, young and old) are able to acquire the education and digital literacy so the internet can improve their lives.

Third, government policy towards how the internet is used within the country will influence the impact of social media on social development. The obvious example is internet censorship which can limit the potential for social media to bring about political aspirational change. The use of the internet for surveillance is also important here, since it may be used to suppress the activities of groups wanting to bring about social change. The countering argument by governments who do censor the internet or conduct internet surveillance is that this is necessary for social stability and national security.

Finally, government's own presence on the internet will be important. Is the government making optimal use of the internet in the delivery of government services? Is government effectively using social media to provide authoritative information to citizens relating to, for example, public health and emergencies or disasters? Government competes with other organizations (e.g. private, non-profit) in the delivery of services and information to citizens. Social media is having an impact on the relative position of government in social and information networks, which 'equips government with a strategic position from which to dispense information' (Hood, 1983, p. 12).[9]

3.3.2 The role of culture

Section 2.3 presented evidence on cross-country variations in social media use; culture could potentially influence how social media impacts on social and economic development in a particular country. Cross-cultural differences in retweet behavior, for example, can impact on the diffusion of information and hence the potential contribution of microblogs to political aspirational change. Culture may also be reflected in how Facebook is used in a given country,

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[9] This is referred to as 'nodality' in the 'tools of government' framework (Hood, 1983; Hood and Margetts, 2007); the other tools or resources are treasure (control of taxation and the money supply), authority (the legal power to forbid, demand, guarantee or

and its potential impact on development outcomes. Utomo (2015) argues that the collectivist nature of Indonesian culture means that Facebook is much more likely to be used for weak tie formation (whereas in Western societies Facebook is regarded as more a tool for maintenance of strong ties). Utomo (2015) argues that this helps explain why Facebook is facilitating the entrepreneurial activities of middle-class women in Indonesia.

4 Social media and economic activity

Social media can benefit business owners and entrepreneurs in developing economies by reducing the cost of communication and increasing opportunities to find business partners and customers (similar arguments are made with respect to mobile phones). However compared with developed economy contexts, there is not much literature on social media and economic activity in developing countries. Nwabueze et al. (2013) claim that social media plays a crucial positive role in achieving microfinance banking goals in Nigeria by facilitating information flow to the poor and small business owners who are the primary target of microfinance. However, it should be emphasized that it is very difficult to disentangle social media effects on business outcomes from other factors (e.g., innate skills and drive of entrepreneurs and business leaders, and the business environments in which they operate), because of data availability and also the general problem of identifying a network effect (Box 10).

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adjudicate), and organizational capacity (the government's stock of human and physical capital).

Is social media good for business? It is tempting to assume that because social media opens up channels for businesses to efficiently connect with customers, suppliers and investors that it must be positive for business outcomes. However, empirically establishing a causal link between social media use and business outcomes is challenging, and relates to the general problem of identifying a "network effect" – the causal link between network structure and the behavior and outcomes of actors (the foundational reference in economics is Manski (1993)). It is in the interests of businesses to use all means available (including social media) to strategically acquire connections (e.g. with customers, suppliers or investors), and those who succeed at this will have improved performance. But is it the social media use and improved network position that is causing the outcome (higher profitability) or is it an unobserved attribute of the business actor (for example, talent or drive) that allowed it to successfully acquire the best network structure and to perform better than its competitors? Establishing a network effect is thus complicated by the possibility of unobserved heterogeneity – variation in network position across agents also reflects the intrinsic ability of the agents, which will also affect performance.

Box 10: Identifying a network effect

In addition, social media enables entrepreneurs to create and maintain weak ties and bridging social capital. While Facebook is generally regarded as being useful for maintaining strong ties such as close friends or kin, Twitter enables entrepreneurs to expand and use their weak ties such as acquaintances. In Fischer and Reuber's (2011) study of entrepreneurs' use of Twitter one interviewee said "Facebook is a cocktail party and so when you are engaged in Facebook you're surrounded, sometimes very peripherally but surrounded, by people that you know and you like and that are part of your social graph. Twitter's not that. Twitter is more like somebody standing on the street corner with a megaphone saying, 'Hey, if you're interested in the Toronto Maple Leafs, check out this article! ' And I may be interested and I

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might check it out or I may just walk right by" (p.3). Through interviewing entrepreneurs, the authors provide evidence that Twitter increases social interaction. Likewise, from a point of view of job opportunities, LinkedIn (a social networking site for professionals) allows users to make connections with those who are in the same circle and out of the circle. This is also helpful for utilizing weak ties, so that individuals can find new job opportunities.

Utomo (2015) notes that the role of social capital in facilitating womens' access to income has been well-documented (see, for example, Mayoux, 2001; Silvey and Elmhirst, 2003) and assesses how Facebook is transforming womens' economic opportunities in Indonesia. The author conducts interviews of women who use Facebook for selling products and presents evidence that the social network site does foster the entrepreneurial activities of these women. However Utomo (2015) is careful to point out that the positive impact of Facebook on entrepreneurial activities may be quite specific to the particular setting of her study. In particular, the author points to the importance of gender and class, since she studied middle-class women in Jakarta who are secondary earners in their families, and for whom conducting income-generation activities via Facebook fitted well with family responsibilities. She also highlights the importance of culture, arguing that Indonesian collectivist culture impacts on the way people use Facebook and hence the ability of Facebook to foster weak ties that could lead to potential sales and finding commercially-relevant information.

Box 11: Facebook and female entrepreneurship in Indonesia

The study of Utomo (2015) is important for the present paper since it highlights the fact that the positive impacts of social media such as Facebook on economic activity will be localized to specific segments of society and this may temper our conclusion regarding the overall potential of social media to transform economic opportunities in a particular country. Further, it is important to be careful not to generalize impacts of social media across countries, since

culture may impact how social media is being used (and hence its potential for influencing entrepreneurial activity).

Social media provides another way of potentially improving economic outcomes in developing economies, namely as a source of business-related "big data". Big data is often discussed in the context of the 'internet of everything' or 'network of networks' and can be thought of as data from networks of (1) people (social web) e.g. phone logs/GPS, social network sites (e.g. Facebook), microblogs (e.g. Twitter); (2) information (traditional web - the WWW) e.g web pages, clickstreams, website logs and (3) things (sensor web) e.g. temperature sensors, medical instruments. Big data refers to not only data that is beyond traditional analytical techniques and computational capacity, but also a phenomenon whereby analysts can access data that are unprecedented in terms of size, dynamics and variety and use these data to uncover and predict a wide range of societal phenomena. Social media is a major source of big data, especially with respect to data on human behavior. The Global Pulse project in Indonesia[10] aims to predict daily food prices using food-related tweets by users in Twitter. The goal is to provide an alternative means of officially monitoring food prices, thereby reducing cost of data collection (incurred by both government and business operators).

Social media also provides opportunities for businesses to conduct experiments, for example, to better understand how social networks affect consumer demand. Aral and Walker (2014) have conducted a large-scale experiment on Facebook and note that social media such as Facebook "enables developers to customize application features for particular users, enabling feature and design randomization" to test product designs, consumer demand and so on (p.1354).

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[10] http://www.unglobalpulse.org/nowcasting-food-prices

Crowd-sourcing sites such as Mechanical Turk and freelancing websites such as eLance are online labor markets that are providing job opportunities for people in emerging economies such as India and The Philippines (Aguinis and Lawal, 2013; Ross et al., 2010). However, some researchers and commentators argue that these types of platforms can be used for exploiting cheap labor.

5 Social media and emergencies

Twitter co-founder Jack Dorsey credits his childhood interest in listening to law enforcement and emergency services on police scanner radios as part of his inspiration for creating the microblogging platform[11]. Today Twitter is increasingly used for coordinating communication and for gathering and disseminating information during emergency, disaster and crisis situations. Government use of social media can educate the public on how to respond/act when disasters or emergencies occur. When a disaster or emergency is unfolding, social media can provide a way for government to provide correct information. However the ability of government to provide useful information to citizens will depend on how influential government is on social media i.e. its centrality or 'nodality' in relevant conversations.

Alexander (2014) reviews social media use by governments during disasters and major incidents. He identified seven functions of social media in disaster situations; (1) a listening function, (2) monitoring a situation, (3) integration of social media into emergency planning and crisis management, (4) crowd-sourcing and collaborative development, (5) creating social cohesion and promoting therapeutic initiatives, (6) furthering causes (e.g. collecting donations after disasters), and (7) research. Reeder et al. (2014) contend that organizational use of social media for emergency response can have two purposes: information dissemination and as a

management tool (e.g. receiving requests for assistance). They summarize research which suggests that social media is generally used only for the former.

US Department of Homeland Security (2013) looked at citizen use of social media during and after Hurricane Sandy, which affected the north-east coast of North America and parts of the Caribbean in October 2012. The authors highlight (p. 17) the ways in which social media enabled multi-way information sharing: (1) government to public (e.g. citizens), (2) private sector to public, (3) public to government (active) e.g. using social media to report problems and needs (for example, via crowdmaps where citizens can collaboratively update information on road conditions during a disaster), (4) public to government (passive) e.g. government monitoring social media such as Twitter and Facebook to identify emerging threats and needs, and (5) public to public.

Box 12: Citizen use of social media during disasters

While government social media use is still nascent, its usefulness and importance is increasingly recognized. Kamel Boulos et al. (2011) studied the use of geo-tagged Twitter data in the context of health surveillance, and found such data is useful for improving public health especially in developing countries such as Cambodia and Thailand. Social media provides an additional tool for monitoring crises such as pandemics, although the concerns raised by Lazer et al. (2014) in the context of using Google search data to monitor flu trends are pertinent here.

Despite the increasing importance of social media during crises and emergency situations, Lazer et al. (2013) found that television was still the primary medium for obtaining information (compared with mobile phones and tablet computers) in the wake of the Boston

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[11] http://www.cbsnews.com/news/twitters-jack-dorsey-on-60-minutes/

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Marathon Bombing 2013. This finding echoed that of Lobb et al. (2012) who pointed to the important role of traditional media such as television and radio during during the Haiti earthquake in 2010. However, it is clear that social media is becoming a powerful additional tool for governments in times of crisis.

Finally, it should be noted that Alexander (2014) also acknowledges some negative aspects of social media use in emergency, disaster and crisis situations. The spreading of incorrect information via rumors is one of them. For example, Castillo et al. (2011, p. 67) note that "immediately after the 2010 earthquake in Chile, when information from official sources was scarce, several rumours posted and re-posted on Twitter contributed to increase the sense of chaos and insecurity in the local population". Social media enables people to share information at an unprecedented scale and speed during emergencies, but the same technology can also be used to efficiently propagate dubious and potentially confusing information (Box 13). Therefore, the use of social media in emergencies thus far can be considered a double-edge sword.

6 Social media and community voice

The Occupy Wall Street movement and in particular, the Arab Spring which started in Tunisia in December 2010 have led some scholars to argue that social media increasingly plays a significant role in political change. Howard et al. (2011) see a clear link between social media and civil unrest during the Arab Spring: "Social media played a central role in shaping political debates in the Arab Spring. A spike in online revolutionary conversations often preceded major events on the ground. Social media helped spread democratic ideas across international borders." Howard and Hussain (2011) state "[i]nterestingly, the recent protest ignitions seem to have occurred without recognizable leaders. Charismatic ideologues, labor-

union officials, and religious spokespeople have been noticeably absent" (p. 43) and Bennett and Segerberg (2013) make similar arguments about the relatively minor role of traditional social movement organizations in the Occupy Wall Street movement.

On the other hand, Gladwell (2010) has downplayed the role of social media in social unrest in the Arab Spring, stating: "People protested and brought down governments before Facebook was invented. They did it before the Internet came along." Gladwell claims that whereas social media is good for creating and maintaining weak ties, it is less useful for strong ties, which enable people to form hierarchy and leadership that are necessary for social change (especially where protest activities may involve personal risk). Participation in risky protest activity may be an example of a 'complex contagion' which requires social affirmation from multiple sources (Centola and Macy, 2007). In this view, rather than playing a key role in fomenting social unrest, social media is regarded as helping communities to coordinate the activities of their members. Comunello and Anzera (2012) argue in the context of the Arab Spring that "the Internet – and especially social media – does not determine the shift from communities to networks: rather it enables it, and makes the networked structure of society more visible, while empowering networked individuals" (p.465). Thus, Gladwell (2010) and Comunello and Anzera (2012) play down the role of social media in the emergence of social unrest, compared with other authors (e.g. Howard et al., 2011).

Taken all together, whereas some researchers point to a relationship between social media use and social unrest, the relationship is "complex and contingent" (Howard and Parks, 2012). A causal impact of social media on social unrest is hard to establish empirically (this is similar to the point made in Box 10). Further, Nisbet et al. (2012) argue that the impact of social media on civil unrest in a particular country will depend on level of democracy. The recent case of so-called "Umbrella Revolution" in Hong Kong was less spread out than the Arab Spring in

terms of scale and impact (despite some instances of sympathetic posts on Sina Weibo, the protests had no widespread impact in mainland China). When it comes to the role of social media in social change, thus, contexts such as level of democracy, network structure (how social media is used by citizens) and censorship or control of social media will have an important role.

Recent research (e.g. Oh et al., 2013; Spiro et al., 2012; Tang and Liu, 2009) has aimed to improve understanding of how rumours are diffused in social media. Oh et al. (2013) showed that the intensity of social crisis influences the quality of information shared on Twitter. Also, other researchers have looked at how misinformation on social media can be countered. Hannak et al. (2014) examined fact-checking conversations in Twitter, finding that as users tweet dubious information, other users reply or retweet with a fact-checking URL (e.g., in the U.S., Snopes.com, PolitiFact.com and FactCheck.org). They found that such fact-checking tweets are more likely to occur between strangers (i.e., neither a pair of users follow each other) than between friends (i.e., a pair of users mutually follow each other). However, there is still a dearth of research investigating misinformation diffused via social media. Further research on collective behavior toward correcting misinformation will be important for understanding the role of social media in social learning in the context of social and economic development.

Box 13: Rumors on social media

Another potential means by which social media can impact community voice and social unrest is via the spread (and countering) of misinformation. The accuracy and authoritativeness of information on social media is often questionable, compared with conventional media (e.g. newspaper, television and radio), since anybody who has access to social media can post whatever he or she wants to share. For instance, Papacharrisi and de Fatima Oliveira (2012) found that tweets in Egypt during the Egyptian revolution of 2011 ranged from news

headlines to gossip and opinions, and there was limited evidence of verification or fact-checking of tweets (p.279).

China's policy of controlling information on the web is enacted via the so-called Great Firewall. Recent studies by King et al. (2013, 2014) investigated the extent of Chinese censorship on social media and found that the Chinese government is much more likely to censor information regarding collective action (e.g. anti-government protests), compared with posts that are critical of the government. For example, posts regarding "protests in inner Mongolia" and "riots in Zengcheng" were significantly more likely to be removed compared with posts highlighting the extent of government corruption such as "Sing Red, Hit Crime Campaign" and "Boxilai meets with Oil Tycoon". The authors concluded that the Chinese government is more afraid of real-world action than critique against it. The research countered the conventional view that the Chinese government constrains expression of citizens by censoring content that is critical of the government, revealing that Chinese censorship is much more flexible than expected (highlighting the importance human-effort in censorship via the so-called "50 cent party" (http://en.wikipedia.org/wiki/50_Cent_Party) compared with automated processes, and also

Box 14: Chinese censorship of social media

Censorship and internet filtering have a major impact on the availability and use of social media, and have been used by governments in an attempt to control information flow among citizens during periods of social unrest. For instance, during the Arab Spring the Egyptian government effectively "turned off" the internet in the country, in an attempt to stop the sharing of information regarding anti-government protests. Government attempts to control internet traffic to prevent social unrest is clearly controversial and may even be counter-productive. Casilli and Tubaro (2011) use agent-based modelling to suggest that the decision to regulate or restrict social media in situations of civil unrest counter-intuitively results in higher levels of violence. They contend that a 'complete absence of censorship …not only

corresponds to lower levels of violence over time, but allows for significant periods of social peace after each outburst' (p. 2).

7 Conclusion

This paper has presented an assessment of the impact of social media on social and economic development, using an analytical framework that draws on the social networks and social learning literature.

It is difficult to provide a conclusive assessment of how social media will impact on development at the global level. The web and social media are relatively recent inventions and research into their impact in developed countries (let alone developing countries) is still on-going and in some situations, contested. Further, it is not clear that social media research in developed countries can be generalized to developing country settings because of country-specific mediating factors (e.g. overall level of development, government policy, culture).

Despite these challenges, we can offer the following tentative conclusions regarding social media and development.

Because of its focus on weak tie formation, microblogs such as Twitter may play more of a role in political aspirational change (such as what occurred during the Arab Spring), compared with technology adoption or economic aspirational change. Research on social interactions in the context of technology adoption and economic aspirational change suggests that strong ties (connections with people who you trust, identify with and are likely to be similar to) are more important, and for that reason, social network sites such as Facebook may be able to play a role in economic development.

Evidence on Facebook use by middle-class women in Jakarta (Utomo, 2015) does point to the potential role of Facebook in fostering entrepreneurial activities however one needs to be aware that Facebook may only impact on the economic outcomes of specific groups in society and cultural factors may also be important, and hence generalizing these findings to other (poorer) parts of society and across countries is difficult.

It may be that social media "in the wild" such as Facebook is less likely to have a role in fostering economic development amongst the poorest communities (ignoring, for the moment, infrastructure and education issues) compared with a more controlled social media intervention. For example, it might be that purpose-built social network sites can be set up by government agencies or multilateral agencies as part of program delivery. Such social media sites could be used as a way of introducing innovations (e.g. new farming techniques or products) and connecting program participants with team leaders as a means of opening the 'aspirational window'. Social media could provide a means of more effectively managing development programs which aim to foster technology adoption and economic aspirational change, drawing on new advances in network science and benefiting from the affordances and convenience of social media.

Finally, country specifics such as the role of government (e.g. how government uses social media, policy towards censorship), the overall level of development (infrastructure, education and hence digital literacy) and culture will influence how social media can impact on social and economic development.

Acknowledgements

Appendix A Social networks and social network analysis

In this appendix we provide a brief introduction to social networks and social network analysis.[12] A network is a set of nodes (vertices or entities) and a set of ties (edges or links) indicating connections or relations between the nodes. In a social network, the network nodes are typically people (however social network analysis is also used to study the behaviour of organizations and groups) and the network ties are relations between people. There are two types of attributes of nodes: graph-theoretic attributes are derived from the network (e.g. number of connections, or "degree"), while non-graph-theoretic attributes are intrinsic to the node (e.g. gender, race, age). Node attributes can be represented in network maps (sociograms) by the color, shape or size of the node. For example, gender might be represented by node color (red for males, blue for females) and node size might be proportional to degree.

Edges in a network can represent different connections (e.g. collaboration, friendship, citations), and there are two major types of edges. Directed edges have a clear origin and destination (e.g. person A nominates person B as an expert in a particular field, Twitter user A follows user B) and directed edges do not need to be reciprocated. Directed edges are represented in sociograms as a line with an arrowhead indicating the direction of the tie. Undirected edges indicate a mutual relationship with no origin or destination (e.g. person A is married to person B, person A is a Facebook friend of person B) and by definition, undirected edges do not exist unless they are reciprocated. Edges can also have weights. An unweighted edge is where the edge either exists or not (e.g. a Facebook friendship either exists or does not), while a weighted edge has a value attached to it that indicates the strength of the

relationship e.g. in a Twitter network an edge that indicates person A follows person B could be weighted by the number of times person A retweeted person B.

There are several types of social networks (see Figure 4). An egocentric network (also known as an egonet, or personal network) consists of a focal node/person ("ego") and the people he or she is connected to ("alters"). A 1.0 degree egonet does not show connections between alters, while a 1.5 degree egonet does show these connections. A 2.0 degree egonet also includes people who are two degrees of separation from ego i.e. friends of the alters who are not also friends of the ego ("friends of friends"). A complete network consists of a set of nodes where all existing ties between the nodes are indicated.

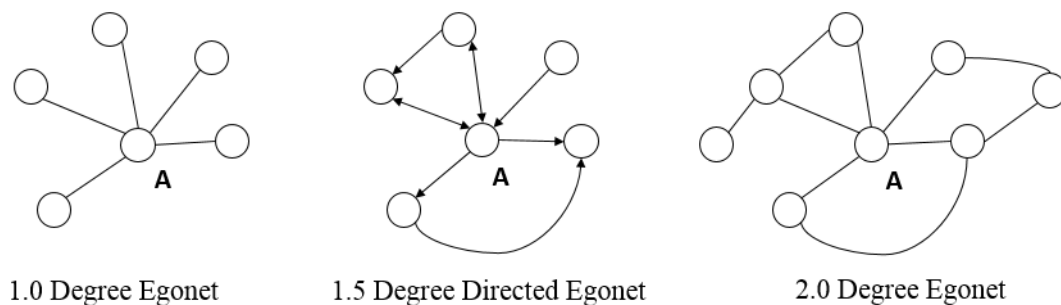| 1.0 Degree Egonet | 1.5 Degree Directed Egonet | 2.0 Degree Egonet |

Figure 4: Egocentric networks

The type of network can also be distinguished on the basis of mode. A unimodal network contains only one type of node or vertex, while a multimodal network contains more than one type of node. A bimodal network contains exactly two types of vertices, and an example of a bimodal network is an affiliation network consisting of people and the wiki articles they have

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[12] For more on social network methods see Wasserman and Faust (2004) and Hanneman and Riddle (2005), and Hansen et al. (2010) provide a useful introduction to social network analysis in the context of social media.

edited. Bimodal affiliation networks can be transformed into two separate unimodal networks, for example, wiki editor-to-wiki editor and article-to-article.

Most social networks are multiplex, that is, actors share more than one type of tie. For example, two people working in a firm may have a tie that describes their working relationship (e.g. person A works on the same team as person B) but they might also be friends outside of work and hence have another type of tie that represents their affective friendship. There are also examples of multiplex online networks. For example, there are three types of ties that could exist between two Twitter users: A *follows* B, A *mentions* B (authors a tweet which starts with B's Twitter username), and A *replies to* B (authors a tweet containing B's username, but not at the start of the tweet). Often multiplex ties are reduced to a simplex tie e.g. a tie is deemed to exist if any of the multiplex ties exists.

Social network researchers have developed a wide range of network metrics that are used to quantitatively describe a given social network and the actors within the network. Some basic node-level metrics which describe the centrality of actors are (see Figure 5):

- *Indegree* and *outdegree* are the number of inbound to and outbound ties from, respectively, a node in a directed network. In an undirected network, the *degree* of a node is the number of ties that node is a part of.

- *Betweenness centrality* indicates the extent to which a node plays a "brokering" or "bridging" role in a network and is calculated by summing up the proportion of all the shortest pathways between the other actors in the network that pass through the node.

- *Closeness centrality* indicates the extent to which a node has short paths to all other nodes in the graph, and hence measures the extent to which the node is in the "middle" of a network.
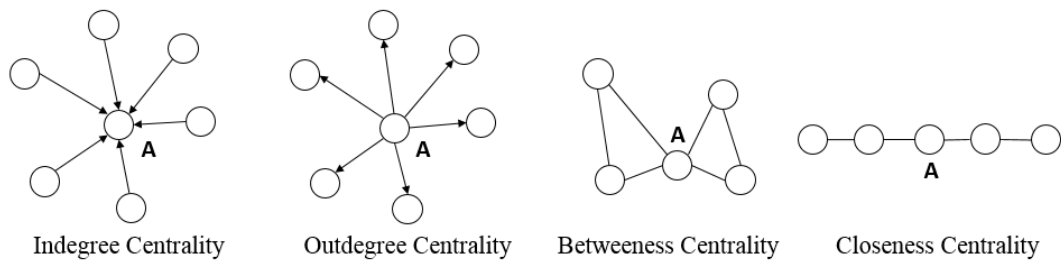
Figure 5: Network centrality - node A is most central, based on the different measures

Some basic network-level metrics are:

- *Network size* is the number of nodes in the network.

- *Network density* is the number of network ties as proportion of the maximum possible number of network ties.

- *Network inclusiveness* is the number of non-isolates as a proportion of the network size.

- *Centralisation* is a network-level property that is calculated for a given node-level property and it broadly measures the distribution of importance, power or prominence among actors in a given network i.e. the extent to which the network "revolves around" a single node or small number of nodes.

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