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Irrigation as a Historical Determinant of Social Capital in India? A Large-Scale Survey Analysis

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Summary. — It is widely understood that the same policy interventions can have different outcomes depending on the social structures they are implemented in. Much less clear though is what fundamentally determines communities' social capital, or the way individuals in a society interact. This study analyzes how irrigation practices, a key feature of agricultural organization in India, affect different indicators of social capital. To this end, an informative household survey is combined with detailed historical agricultural statistics on irrigation and grain cultivation. The depth of the datasets allows for fine-grained analysis of effects of different kinds of irrigation on groups with varying degrees of involvement in the agricultural production process. I show a significant negative influence of specific types of irrigation on the prevalence of conflict and an increased likelihood for attendance of public meetings, yet it is not possible to establish a broad and consistent relationship between agricultural indicators and social capital, which contradicts previous research. Furthermore, specific groups with varying incentive structures based on their land-holding status and agricultural engagement appear to be affected by different kinds of irrigation. The results underline the need for a multidimensional analysis of both social capital and agricultural organization, as well as their interaction. I do not find evidence supporting the rice theory of culture.

Key words — determinants of social capital, agricultural organization, irrigation, India

1. INTRODUCTION

During the last three decades, economists' interest in the concept of social capital as a fundamental factor in economic production has risen steadily (Guiso, Sapienza, & Zingales, 2004; Knack & Keefer, 1997; Tabellini, 2010; Zak *et al.*, 2001) and its influence on economic development is increasingly acknowledged (Woolcock *et al.*, 2000; World Bank, 2015). At the same time, significant differences remain between countries and world regions regarding their measured social capital "stock", despite similar education and developmental achievements. The drivers of these variations are not fully understood yet. A number of works (Alesina, Giuliano, & Nunn, 2013; Cohen, Nisbett, Bowdle, & Schwarz, 1996; Gneezy, Leibbrandt, & List, 2015; Henrich, 2004) have looked at the relation between our ancestral means of subsistence, e.g. farming practices and hunting organization, and the way we structure our societies. Yet, irrigation as a characteristic practice in many agricultural societies has so far not received adequate attention from an econometric perspective. This is despite early mentioning of its potential importance for societal structures by Marx (1867, chap. 14.4) and Wittfogel (1957). In the latter's notion of "hydraulic societies", it is the need to harness the power of water for purposes of irrigation or in defense of one's home area that made ancient societies, e.g. in the Middle East, develop elaborate administrative structures much earlier than societies living in agro-ecologically more advantaged world regions. More recent work by Talhelm *et al.* (2014) has focused on the prevalence of wheat vs. rice in cultivation, where the associated agricultural practices are thought to have a long-term impact on societal organization.

The present study combines two datasets to add to this discussion for another world region, which is India. The wealth of agricultural and household data allows to separate the effects of grain sorts and irrigation practices on different indicators of social capital. This can be analyzed for both historical and current explanatory variables, as well as for groups with differing degrees of agricultural engagement. Fortunately, agricultural data series were initiated before or during the early phases of the "Green Revolution" in India, allowing the capturing of historical agricultural patterns using the earliest available data. Furthermore, different aspects of social capital, e.g. confidence and membership in organizations can be analyzed separately with the data at hand, along with the prevalence of conflict and engagement in public affairs.

The case of India is important in this debate as it not only geographically, but arguably also socially lies between the Western and Eastern hemispheres and its natural environment fostered the cultivation of various crops with differing methods, so that specific effects of grain sort and cultivation method can be isolated. The relevance of this study can be understood when looking at recent large government initiatives like "Rurban" (Ministry of Rural Development, 2015), which, in attempting to boost rural infrastructure and services toward urban levels, might be facing different social structures depending on what agricultural practices prevail in different areas. The same holds true for a proposed push in irrigation development (Ministry of Agriculture & Farmer's Welfare, 2015).

The remainder of this paper is structured as follows: Section 2 defines the paper's understanding of social capital and provides an overview of related studies. Section 3 presents characteristics of grain cultivation in India and associated irrigation practices. Section 4 states the main hypotheses, describes the dataset and introduces the econometric model. Section 5 presents the results of the central set of regressions. Finally, Section 6 presents robustness checks, before Section 7 discusses the results and concludes.

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2. SOCIAL CAPITAL AND ITS DETERMINANTS

Various aspects of social capital, such as trust, network width, or individualism/collectivism, have been analyzed to explain differences in economic indicators such as growth, saving behavior, or prosperity (e.g. Gorodnichenko & Roland, 2011; Greif, 1993; Knack & Keefer, 1997; Narayan & Pritchett, 1999). Often-cited definitions of social capital which also guide this present work come from Bourdieu (1986, chap. 9) and Putnam (1993), where social capital is defined as "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition" (Bourdieu, p. 248). For Putnam, the essential aspects are "trust, norms and networks that can improve the efficiency of society by facilitating coordinated actions" (p. 167). While the importance of these concepts is firmly established in the economic literature, the persistent differences between countries remain largely unexplained. One prominent example is the socio-structural divide between countries of the "West" and those of the "Far East", where surveys of the former show high measures of "individualism" versus a higher degree of "collectivism" in the latter (Hofstede, 2015). This ranking does not seem to be primarily determined by income, wealth or education of a particular country, with Japan and South Korea ranking far below less developed nations such as Hungary or the Baltic States in terms of measured individualism.

A recent study by Talhelm *et al.* (2014) makes a fundamental contribution in offering a history-based explanation for the roots of these persistent differences, which the authors call the "rice theory of culture". In their study of Chinese students, those coming from areas with prevalent rice cultivation score significantly higher on various measures of collectivism than those from neighboring and therefore assumed as comparable districts characterized by wheat cultivation. The authors therefore hypothesize that the major importance of rice cultivation in East Asia versus wheat cultivation in countries of the West is one fundamental reason for persistent observable differences in social capital between these two world regions. The specific demands of rice in cultivation (labor intensity and irrigation requirements) require rice-growing societies to act in a more coordinated and communal way than the comparative independence of wheat cultivation.

In its basic argument, that the organization of food production as the central occupation for the majority of people throughout history has shaped societal behavior and organizational forms, the present study follows other scholars that have explored this nexus. Notable examples include the study of fifteen indigenous societies by Henrich *et al.* (2001), which shows that the degree of cooperation required between individuals during food acquisition is related to cooperation in experimental settings. A study with a related approach comes from Gneezy *et al.* (2015) who explore variations in cooperative behavior in experiments with Brazilian fishermen, with groups fishing either collectively at sea or individually at a nearby lake. Through a series of economic games, they find a strictly higher willingness to cooperate among sea-fishers. There are also examples of social norm generation and transmission from agricultural factors: a study by Cohen *et al.* (1996) relates today's aggressive potentials of Southerners in the USA to the cultural heritage of British pastoralists who first settled today's southern USA and were used to having to defend their territory, whereas Northerners trace their roots more frequently back to British farmers, bringing with them a culture of cooperation and coordination. These general results are confirmed by Grosjean (2014), specifically in areas where historical institutional quality was low. Alesina *et al.* (2013) find a correlation between today's role of women in society and the historical onset of plow usage, thereby building on a hypothesis from Boserup (1989), where physical exertion and lack of opportunity for taking breaks when working with the plow prevented shared work on the field and thus influenced today's gender norms. A related theory comes from Wittfogel (1957), whose term "hydraulic societies" implies the central role of water harnessing in fostering a strong and effective state. Early civilizations, such as the Egyptians, Babylonians or the Indus valley culture therefore profited from their centralized structures, which in turn were a result of the need to coordinate in water management. Regarding rice cultivation and associated irrigation, besides the mentioned study by Talhelm *et al.* (2014), relevant work comes from Tsusaka, Kajisa, Pede, and Aoyagi (2015). By combining survey, experimental and econometric data, the authors show that the adoption of altruistic and cooperative behaviors is higher among a sample of Filipino farmers practicing irrigation vis-à-vis rain-fed agriculture. For cooperative behavior, the neighborhood effect is stronger among farm plot neighbors than among residential neighbors, providing evidence for the binding effect of common labor in the field. Furthermore, a study by Munshi (2004) finds differences in social learning regarding agricultural technology adoption between wheat and rice farmers in India. Mustafa and Qazi (2007) point to the importance of different forms of irrigation in their relation to social capital. They find that the spread of electric tubewell pumps in Pakistan's Balochistan province is replacing the historically community-administered "*karez*" systems, with villagers expressing concerns about the erosion of the social cohesion in the community. Given the rapid spread of tubewells in many regions of India during the Green Revolution (see Figure 6 in the Annex and following section), it will be important in the following analysis to differentiate between different forms of irrigation as well as the changes over time.

The nexus between irrigation and social capital has also been famously explored by Elinor Ostrom (1990) and coauthors (Lam *et al.*, 2009; Ostrom & Gardner, 1993). In her work, irrigation serves as a prime example of a common pool resource that requires communal effort to be maintained, and invites free-riding on behalf of the individual owner. However, the question of what fundamentally determines whether a society is able to cooperate or not, be it in irrigation or outside of it, is not directly addressed in this research. Arguably, and as further explained below, irrigation is a technique whose local potential for application is largely determined by (as good as randomly distributed vis-á-vis initial population characteristics) agro-ecological conditions, and even more so when seen over a longer time span where technologies can disperse through space. It is therefore helpful to look at irrigation not only as an example of social action, but also as a foundation of it, shaping the way people see themselves in relation to others. In her seminal work "Governing the Commons", Ostrom (1990) cites the case of the "Huerta irrigation institutions" in southern Spain as having their roots in pre-medieval times, and coming with a large set of associated practices that regulate the sharing of water and the maintenance of canals, enabling farmers to cultivate the otherwise harsh environment harnessing the main river of the area (p. 69). It is thus based on a given agro-ecological condition that an effective system has been developed and maintained over centuries, enduring changes of political rule and large shifts in cultural habits. Another example from her work supporting historical foundations of social capital is the introduction of large-scale irrigation in previously unirrigated areas by the British colonial

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