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Social Capital and Improved Stoves Usage Decisions in the Northern Peruvian Andes

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Summary. — This paper explores how village level technology usage patterns and bonding social capital (the strength of intra-communal links) mutually influence the individual usage decision of an improved stove in the Peruvian Andes. It shows that the individual usage likelihood is more responsive to village usage patterns if communal bonding links are relatively strong, and that bonding social capital discourages individual usage if the proportion of beneficiaries experiencing usage problems is relatively high. Usage problems were mainly related to faulty stove's materials, which were likely exogenous to households' characteristics. Social capital was measured before the intervention, which alleviates reverse causality issues.

Key words — technology adoption, bonding social capital, improved stoves, Peruvian Andes

1. INTRODUCTION

In recent years, the empirical development literature on technology adoption has highlighted the role of social learning and information diffusion in rural communities, mainly in the context of new agricultural technologies (Bandiera and Rasul, 2006; Foster and Rosenzweig, 1995; Isham, 2002 ; Munshi, 2004; and more recently Conley and Udry, 2010). However, although a significant variety of issues related to social learning has been explored in great detail, [1] little attention has been given to understanding how the nature and extent of village social relationships (social capital) facilitates (or does not) social learning; nor to how village level performance patterns of a new technology influence the type of effects that village social links will have on the individual adoption decision.

Using data from an improved cookstove dissemination program in rural communities in the Northern Peruvian Andes, this paper explores how village usage patterns and village social capital mutually affect the household's likelihood to effectively use a new stove technology within the first year of its introduction. It also explores the roles played by different dimensions of social links (bonding *vs.* bridging social capital) in the context of technology adoption decisions. This paper focuses on the decision to effectively use the new stove as the main cooking device only among beneficiaries; that is, households that received the new device (for free) during the distribution stages (approximately 85% of all households in the study area).

As is the case for new agricultural technologies, being able to effectively use an improved stove is not a straightforward process, given that the "*modus operandi*" of these devices differs in many aspects from that of traditional open fire stoves. [2] In this sense, experimentation and learning by doing are critical for rural households in order to determine whether or not to effectively use an improved stove as the main cooking device. Qualitative evidence from the study area suggests that in some villages the knowledge generated by experimentation and learning by doing was intensively disseminated, while in others it was, at best, poorly diffused. [3]

Like other studies in the technology adoption literature, this paper's results suggest that households learn from their village neighbors about a new technology. However, its main contribution is to provide empirical evidence that supports the hypothesis that information diffusion and social learning are mutually influenced by village-level technology usage patterns and village bonding social capital, which can be understood as the strength of intra-communal links (Woolcock, 1998), and is measured in this paper by the village-level trust in local neighbors. More precisely, this study shows that the individual usage likelihood appears to be more sensitive to the usage patterns within the village in those communities with higher levels of bonding social capital; and that if success in improved stove usage within the village is low (or failure is high) bonding social capital is more likely to negatively influence the individual usage decision (as in this case social links are likely to intensively diffuse negative information about the new device). In addition to this, the results indicate that bridging social capital, defined as the strength of social ties across villages and measured by the village-level trust in people from other communities, only seems to influence the impact that usage patterns outside the village have on the individual usage decision. An essential advantage of this research, compared to others that have also explored the informational role of social capital in the context of technology adoption in rural communities (see for example Isham, 2002), is that social capital was measured

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prior to the intervention; thus, reverse causality should not be a critical issue for identification purposes.

Adoption or usage decisions may be correlated among households within the same village just because they are subject to the same unobservable characteristics and shocks, especially in communities with high levels of bonding social capital. To support the hypothesis that social learning is the generating process in the data, first we exploit an improved stove performance monitoring survey (carried 8–12 months after stove distribution) to define two types of village usage patterns: (i) the village proportion of beneficiaries who reported using their improved stoves without any complication and (ii) the village proportion of beneficiaries who reported using their new device with problems. These problems were mainly related to faulty stove materials, which the evidence suggests were likely exogenous to households' and villages' characteristics. Secondly, an interaction term between beneficiaries' usage patterns and the bonding social capital indicator is introduced. Our results indicate that only the interaction term between the proportion of beneficiary users without problems and the bonding links indicator has a positive and significant effect on the household's usage decision; while the opposite is true for the proportion of beneficiary users with problems. Finally, we also explore the decision to dismantle the new stove among beneficiary nonusers. The results in this case, indicate that an increase in the village proportion of beneficiary users that report problems with the new stove augments the likelihood of dismantling the device, mainly through its interaction with bonding social capital, which suggests that it is unlikely that correlated unobservables are driving our main findings. This paper's results are related to the findings by Conley and Udry (2010), who show that pineapple farmers in Ghana tend to adopt the fertilizer usage levels of reference neighbors experiencing successful returns.

This study extends the social learning evidence to a technology that is not of an agricultural nature, and supports the informational role commonly attributed to social capital in the literature (Dasgupta, 2005). Section 2 of this paper discusses the improved stove intervention and the beneficiaries' usage patterns data. Section 3 discusses the social capital concept, the reliability of trust measures, and presents the social capital data. Section 4 discusses the methodology. Section 5 presents the baseline results. Section 6 analyzes the dismantling decision. Section 7 provides evidence suggesting that fashion and social acceptance are not likely to drive our main findings. Section 8 contrasts the roles played by bonding and bridging social capital. Finally, Section 9 concludes.

2. THE IMPROVED STOVE INTERVENTION AND THE BENEFICIARIES' USAGE PATTERNS DATA

In the fall of 2003 improved firewood stoves with a metallic chimney (see Figure 1) were freely distributed and installed by the local Non-Governmental Organization (NGO) MIRHAPSERU in 37 villages within the Chalaco District. These villages are located in five watersheds ataltitudes between 1,000 to 3,000 m, in the Northern Peruvian Andes. Improved stove distribution was coordinated and implemented at the watershed level, and a specific NGO team was allocated to each watershed. The intervention was financed by the Spanish International Cooperation Agency, and its main objective was to alleviate forest degradation and to improve adult women's and infants' respiratory health. [4]

The NGO held open and well publicized meetings in every village in order to explain the program's benefits. Following these meetings, an improved stove was allocated to every household who requested one. Beneficiaries were provided with an iron frame and an aluminum chimney, but they had to provide the mud bricks [5] for building the combustion box. Installation was also free and supported by two village craftsmen selected by the beneficiaries and trained by the NGO. Beneficiaries were not required to uninstall their "open fire" stoves in order to get the new one installed. [6] NGO internal reports indicate that 85% of all households in the district received an improved stove and that by the end of 2003, 95% of the new stoves were installed.

All the beneficiaries received the same stove design, along with the same instructions for installation, usage, and maintenance. A second distribution round was originally planned; however, due to administrative difficulties and other program priorities, it was finally canceled. Households that initially did not ask for an improved stove could only have access to one by getting it transferred from another household. Monitoring interviews carried out during the spring and summer of 2004 indicate that these cases were extremely rare (less than 0.5% of the initial beneficiaries reported selling or transferring their new stoves).

(a) *Improved stoves beneficiaries' usage patterns: The 2004 stove monitoring survey*

From April to August 2004 (8–12 months after stove introduction), MIRHASPERU and Universidad de Piura monitored beneficiaries' stove performance in 26 villages. Visits to all villages were originally planned; however, especial emphasis was set in visiting villages in less accessible areas, where relatively low usage rates were expected. [7] It is important to mention that visits were not planned based on the expected level of village social capital, as the social capital survey's results were not available at the time of these visits. Due to budgetary constraints some villages were finally not visited. [8]

Table 1 indicates that 82% of the beneficiary households were visited per village. There is no evidence on beneficiary households refusing to be interviewed. In most cases noninterviewed households were not at their dwelling units; some were out for social visits or buying food or tools in the main district town, while others were still working at their farm plots. In many situations, monitors simply ran out of time during the visits. Table 1 also indicates that approximately 45% of the visited beneficiaries per village reported using the new stove as their main cooking device. [9] Among them, 28% reported some problem with the technology (that is, on average 12% of the beneficiaries per village were using the improved stove with some problem), and 72% did not report any problem (that is, on average 33% of the beneficiaries per village were using the new stove without any problem). The proportion of beneficiaries in the second group, "the village proportion of beneficiary users without problems," serves as an indicator on two levels: it gauges the village level of information on how to properly use the new stove, as well as the village level of information related to "positive" improved stove performance. Conversely, beneficiaries in the first group; "the village proportion of beneficiary users with problems," are likely to play an opposite role, and are expected to negatively influence the individual usage likelihood.

Table 2 shows that beneficiary users with problems were basically affected by material deficiencies; mainly iron frame (deformations and cracks) and metallic chimney failures. In the case of iron frame failures (which affected nearly 60% of beneficiary users with material problems), the evidence from the monitoring reports suggests that these were not