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What Determines Access to Piped Water in Rural Areas? Evidence from Small-Scale Supply Systems in Rural Brazil

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Summary. — This paper investigates whether small-scale water supply systems implemented and operated by water user associations increase access to piped water supply in rural Brazil by more than systems by local governments. Starting from 15% to 16% in the year 2000, access rates in rural areas with water user associations increased to 33.4% in 2010. In areas with local government supply systems, access rates only increased to 24.9%. Based on data from Brazilian census and the national water and sanitation survey, the empirical analysis in this paper shows that the observed difference is effectively due to project-type choice. Additionally it points toward higher accountability as a potential reason for better results of community-based projects. In municipalities where social groups requested a new system before the local government started implementation and therefore public awareness for the project was higher, the increase in access rates is comparable to the increase in municipalities with water user association projects. The same is true if local media is present or political competition in local elections is higher.

As the effect of project type on access rates might be confounded by simultaneous drivers of project-type choice and access rates, the quantitative analysis is based on a difference-in-difference estimator in combination with kernel matching to overcome the endogeneity of project type. The treatment effect revealed by this analysis is robust to various specification changes and the robustness checks show no structural differences between treatment and control groups that could bias the results. The calculation of matching weights for the kernel matching is informed by semi-structured interviews with academics and sector experts in Brazil explaining the determinants of project choice. The interviews highlight the political economy behind infrastructure expansion in rural Brazil.

Key words — water supply, community-based development, rural development, Latin America, Brazil

1. INTRODUCTION

Access to piped water has been increasing considerably in urban areas of the developing world over the last two decades. In rural areas, however, it is still lagging behind: Only 28% of the 1.6 billion people who gained access to piped water on premises during 1990–2012 live in rural areas (Joint Monitoring Programme, 2014b, p. 16). Worldwide, only a total of 29% of the rural population have access to piped drinking water on their premises today (Joint Monitoring Programme, 2014b, p. 29). These figures show that most of the rural population are still deprived of safe, convenient, and cheap access to water. Access to piped water reduces significantly the risk of water-related diseases if compared to more basic solutions of access (Gamper-Rabindran, Khan, & Timmins, 2010; Jalan & Ravallion, 2003). It also increases the quantity used for all types of water-related activities and increases non-health related welfare by reducing the time spent on fetching water (Devoto, Duflo, Dupas, Pariente, & Pons, 2012; Ilahi & Grimard, 2000). Thus providing access to piped water to the rural population has become a policy priority in many middle income countries, which already have high levels of access to basic, so-called improved sources of water. [1] Brazil, for example, declared universal access to piped water a policy priority for the next twenty years (Cidades, 2011).

While the goal is thus clear, the way increases in access rates to piped water in rural areas can be achieved most effectively has been discussed for the last four decades. Two central insights emerged from this debate so far. First, centrally supplied large-scale infrastructure for household connections as in urban areas is not an efficient solution in most rural areas in developing and transition countries. Low population density in rural areas impedes economies of scale, and remoteness from urban areas makes timely operation and maintenance by staff from central suppliers difficult (Cairncross & Valdmanis, 2006; Churchill, 1987; Isham, Narayan, & Pritchett, 1995). Second, the experience with donor-driven aid projects focusing on small-scale supply systems in rural areas has shown that top-down implementation of small-scale supply systems does not work either in most rural areas. Anecdotal evidence from the 1970s and 1980s shows that especially wells and stand pumps put in place by governments and development agencies in rural areas without taking into account local needs and requirements were mostly found in disrepair and unused only after a short time. In some places, rural communities did not perceive new wells and standpipes as improvements over the old wells and buckets they had been using so far and continued to use traditional sources (Briscoe & de Ferranti, 1988). In other places, the communities did not feel responsible for systems implemented by external agents and did thus not contribute to their maintenance (Kleemeier, 2001; Whittington

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et al., 2009). Based on these experiences, development experts started to recommend demand-driven and participatory approaches in order to set up successful small-scale water supply systems in rural areas. The idea was that if users choose convenient technologies and service levels and contribute money or labor, they would use the new supply facilities and increase sustainability of the systems by taking care of operation and maintenance (Joint Monitoring Programme, 2000; World Bank, 2003). Today, community-based, demand-driven projects are ubiquitous in the developing world (Mansuri & Rao, 2004; Prokopy, 2009).

Do participatory projects live up to these expectations and lead to better access to safe water in rural areas? The quite extensive literature on the effectiveness of community-based projects in health and education in principle attests good performance with respect to the quality and quantity of service delivery. [2] Evidence from the supply of drinking water is, however, limited. The existing research focuses mostly on the determinants of success of community-based drinking water projects at the household or village level by comparing different types of community-based projects (Isham & Kähkönen, 2002; Madrigal, Alpízar, & Schlüter, 2011; Marks & Davis, 2012; Prokopy, 2004, 2005, 2009; Sun, Asante, & Birner, 2010). While insights into the inner mechanisms of community-based participatory projects are indispensable to inform successful project design, these studies cannot establish whether non-participatory projects would perform worse in comparison (Mansuri & Rao, 2013). Yet, only this finding would enable evidence-based policy approaches and legitimize the huge investments into participatory water supply projects, which are currently undertaken all over the world.

Only a very small number of papers tries to compare community-based participatory projects to traditional non-participatory top-down projects. Newman *et al.* (2002) find with a small sample from Bolivia that water quality of wells from community-based participatory projects is better than water quality from old, centrally implemented wells if the community gets trained in maintenance. Sun *et al.* (2010) find in a cross-sectional analysis that the mere presence of a water and sanitation association in villages in rural Ghana correlates positively with higher access rates to safe drinking water and with better quality of the water. Narayan (1991) and Isham *et al.* (1995) find in a document-based review of 121 rural water supply projects in Asia, Latin-America, and Africa that more intensive participation forms lead to higher access rates to safe water. Sara and Katz (2005) analyze field data from 125 rural water projects from all over the developing world in the 1990s. They find that the more the projects were demand-driven, the more sustainable they were over time. All projects in this study were, however, meant to be managed and operated by the users after implementation and therefore government projects, that were implemented in a traditional non-participatory way, were as such not truly non-participatory at the stage of evaluation. [3] Although the results of these studies are very suggestive, the analyses are either descriptive by definition or are based on cross-sectional estimators, which do not allow for reliable conclusions. This literature thus does not allow answering the question whether community-based participatory water supply projects increase access to safe water by more than projects implemented and managed by government units without user participation. This paper tries to close this gap with an econometrically sound evaluation of participatory versus non-participatory drinking water projects in rural Brazil.

For this it evaluates and compares the increases in access rates to piped water on premises with two different types of small-scale water supply systems which were implemented in rural Brazil during 2000–08: systems implemented, operated, and maintained by water user associations following a participatory approach and systems implemented, operated and maintained by local governments without any specific user participation.

Apart from this contribution, the present paper improves on the econometric approach used in the literature on community-based water supply so far. The main methodological issue when comparing two types of projects is the endogeneity of the project type. Communities in which water user associations implement projects to improve water access could be systematically different from communities with non-participatory projects. If one of these differences, for example higher bureaucratic efficiency of the municipal administration, increases the probability of a participatory project and the outcomes of the new water supply project at the same time, the effect of interest—the effect of user participation on access rates to piped water—could be driven by this third variable. [4] In order to address this issue, this paper uses a large panel of Brazilian municipalities and a difference-in-difference estimator, which controls for all unobserved time-invariant heterogeneity that could affect project-type choice and project outcomes at the same time. The difference-in-difference estimator is complemented by a multinomial matching approach (Lechner, 2001). Matching assures that the treatment municipalities with participatory water supply projects are as similar as possible to the control group with non-participatory local government projects with respect to all time-invariant and time-varying observable variables, which could simultaneously determine access to piped water and project type choice. In order to shed light on the circumstances and drivers of project choice, the estimation of propensity scores for the matching is informed by semi-structured interviews that were conducted with municipality officials and experts from the water sector in Brazil. In the absence of a natural or quasi-natural experiment, this combined strategy of a matching and difference-in-difference estimator to control for all systematic differences between the two project groups allows to come as close as possible to the causal effect of user participation on access rates in rural areas. Several robustness checks and checks for structural differences between treatment and control group underline the validity of this econometric approach.

This paper also contributes to the literature on decentralized service delivery in developing and transition countries. In Brazil, the smallest jurisdictional unit, the municipality, is responsible for local service delivery in health, education, and water and sanitation (Arretche, 2004). Furthermore, mayors and municipal councils are re-elected every four years and therefore directly accountable to the beneficiaries of local service supply. Such a setting can have two opposing effects. On the one hand, local politicians and officials are supposed to know better about the needs of their constituency than higher government layers and, due the re-election constraint, they probably will also better respond to these needs (Bardhan, 2002; Seabright, 1996). On the other hand, decentralized financial and program responsibilities also increase the risk of corruption of the democratic process by local elites (Bardhan & Mookherjee, 2006). There is evidence from developing countries that, if electoral accountability is low, earmarked public transfers by the central level to local government units may be diverted by local elites (Reinikka & Svensson, 2004), or that (non-earmarked) local budgets may be misused by local officials in order to cater to their families or networks (Sjahrir, Kis-Katos, & Schulze, 2014). These two effects allow for interesting hypotheses for this study. In principle, both types of projects, community-based projects and projects by local

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