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Diversification Strategies and Adaptation Deficit: Evidence from Rural Communities in Niger

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SUMMARY

The paper provides fresh empirical evidence on the adaptation process in Niger rural communities using original longitudinal socio-economic panel data merged with granular geo-referenced climatic information. We identify the main drivers and impacts of crop and labor diversification which constitute two livelihood strategies on moderating the adaptation deficit. In doing so, we account for the interdependence between the two diversification practices and potential reverse causality between welfare outcomes and diversification behavior. Moreover, we condition the impacts of diversification on different sections of the welfare distribution to capture potential non-linear effects. Our results reveal that the diversification has positive and significant welfare impacts when most vulnerable households rely on it as an adaptation strategy to mid-run climate variability and as a coping strategy to short-run market shocks. At the same time, our results find lower but still positive impacts for well-endowed households that are likely to diversify their activity portfolio. Given the very limited presence of policy support, we conclude that the rural Nigerien communities are characterized by a large and autonomous adaptation response which constitutes a key leverage mechanism for policy makers. We thus suggest government interventions aimed at supporting the most important diversification drivers, but also aimed at straightening some channels, such as network infrastructures or the promotion of local crop varieties, which may have a greater potential in triggering diversification.

1. Introduction

There is overwhelming consensus that global climate change is altering the variability of rainfall, temperature, and other climatic parameters and that these modifications will probably lead to an increase in the incidence of environmental disasters (IPCC, 2012; Kahn, 2005; Parry, Rosenzweig, Iglesias, Livermore, & Fischer, 2004; Toya & Skidmore, 2007; Olsson et al., 2014 among others). Although it has been estimated that up to 40% of the world's land surface will develop novel climates (Williams, Jackson, & Kutzbach, 2007), "climate change, variability, and extreme events [will] make the poor even poorer" (Noble *et al.*, 2014). The hypothesis that the consequences of extreme events and climate anomalies will affect poorer countries more than richer ones is also confirmed by the World Bank (2013). In addition to exogenous factors, such as geographical position and concentration of populations in hazard zones, the reason lies in the so-called 'adaptation deficit' (Barr, Fankhauser, & Hamilton, 2010; Brooks & Adger, 2004; Tol & Yohe, 2007; Yohe & Tol, 2002). Adaptation deficit entails a situation in which a country experiences a lack of institutional, economic, and technological means to facilitate the adaptation process. The literature identifies a set of additional individual factors that can raise the vulnerability level such as gender, age, health, social status, ethnicity, and class (Adger *et al.*, 2009; Smit *et al.*, 2001). It is thus clear that communities living in the poorest countries whose livelihoods are directly climate sensitive show a weaker resilience capacity to climate change impacts and a reduced ability to deal with adaptation measures (Fankhauser & McDermott, 2014).

According to Pearce *et al.* (1996) and McCarthy (2001), Sub-Saharan Africa (SSA) represents a major source of concern for future climate change impacts as a result of its strong dependence on subsistence agriculture in marginal and degraded rainfed lands (Cooper *et al.*, 2008; Mendelsohn & Dinar, 2009; Seo, Mendelsohn, Dinar, Hassan, & Kurukulasuriya, 2009). These areas are affected by

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weather changes, short-term anomalies, and long-run climate variability which can severely reduce yields, undermining the availability of both food and feed (Calzadilla, Zhu, Rehdanz, Tol, & Ringler, 2013; Challinor, Simelton, Fraser, Hemming, & Collins, 2010) and increasing vulnerability for sectors of the population (Morton, 2007). In this setting, adaptation processes against extreme climate events emerge as effective strategies to be undertaken by the most exposed communities (Adger, Huq, Brown, Conway, & Hulme, 2003), both at the national and local level (Thornton, Jones, Alagarswamy, Andresen, & Herrero, 2010). In particular, local processes have given rise to a flourishing empirical literature aimed at measuring the impact of adaptation in developing countries exposed to climate risks (for a recent review, see Asfaw *et al.*, 2015). However, a growing concern for rapidly expanding population dynamics and the increasing risks due to climate variability call for additional evidence in order to provide information on the effectiveness of livelihood options available to the most vulnerable communities and correctly support policy makers.

Since climate variability interacts with other non-climatic factors such as lack of natural and economic assets, most vulnerable communities have even lower livelihood capacities. This interaction results in context-specific conditions of marginalization, multidimensional vulnerability, and differential impacts. Accordingly, the status of vulnerability of subsistence farmers is moreover exacerbated by market shocks which translate into high agricultural input and food prices, thereby undermining the food security of already stressed households (HHs) (Morduch, 1995; Timmer, 2000). Vulnerable communities living in rural areas characterized by low income, a minimum educational level, a lack of technical knowledge as well as insufficient policy responses and safety nets, are those affected the most by the consequences of these complex interactions. Thus, the degree to which households increase their resilience to continuous changes is dependent on access to strategic assets, which also identifies their capacity to cope *ex-post* or adapt their livelihood in the long term (Eriksen, Brown, & Kelly, 2005; Folke *et al.*, 2002). In this context, whereas adaptation can be seen as a structural adjustment to actual or expected long-term variation, coping is a process through which the HH moderates, mainly with reversible and purely reactive actions, the potential impacts of perceived random climatic anomalies (Folke *et al.*, 2002; Pelling, 2010).

Among the different contributions that have analyzed the impact of climate change on adaptation strategies in SSA countries, Niger—one of the most vulnerable countries—has surprisingly received very little attention. Niger constitutes an interesting case for analysis since it represents a critical area for climate variation and, at the same time, a highly vulnerable country in terms of potential capabilities to face climatic events and economic shocks (Pachauri, Meyer, Plattner, & Stocker, 2015). Different factors can potentially make Nigerien communities particularly reluctant to implement effective adaptation measures, including a high presence of extensive rain-fed subsistence agriculture, very low education rates and a lack of policy supports. These elements constitute tangible and intangible barriers to adopting adaptation practices which may result in adaptation lock-in and leads to "wait and see" or reactive approaches, low cognitive learning, misperception, and insufficient awareness of climate risks with inefficient adaptation response to extreme events (Baird, Plummer, Haug, & Huitema, 2014; Le Dang, Elton, Nuberg, & Bruwer, 2014). In some cases, these barriers can also lead to competing behaviors of indigenous traditions versus modern and more effective adaptation strategies (Baird & Gray, 2014).

In light of this, our contribution to the existing literature is manifold. Given the limited evidence on the use and impact of diversification practices from the Sahel area at large, and from Niger in particular, which is largely attributed to the lack of reliable data from this country, our analysis adds great value in filling this gap in the existing literature. We employ a large longitudinal national representative HH level survey with rich socio-economic information, merged with detailed geo-referenced climatic information to identify the farmers' diversification strategies and their impacts on welfare. To the best of our knowledge, there are no studies that have looked at this issue in a rigorous manner in Niger by employing a panel dataset. Moreover, we explicitly consider the possibility that farmers rely on a mix of diversification options using a seemingly unrelated regression (SUR) model which accounts for potential interdependence between different diversification practices. The impact of diversification practices is estimated through two welfare indicators using instrumental variable techniques and is conditioned to different levels of the welfare distribution by means of quantile regression.

The remainder of the paper is as follows. Section 2 describes the theoretical background and presents the conceptual framework. Section 3 introduces the interesting case of Niger. The data are presented in Section 4 together to some preliminary analysis, while the empirical methodology is provided in Section 5. Section 6 includes the model results and Section 7 concludes with some policy implications and limitations of the study. The final Appendix provides further research material.

2. Conceptual framework

Several studies have investigated the effect of coping and adaptation strategies in stabilizing and adjusting the livelihoods of rural communities when facing the adverse effect of climate risk. The literature has analyzed the impact of migration, climate smart agricultural practices, and modern technologies adoption, safety-net programs, micro-credit, and diversification (Bazzi, Gaduh, Rothenberg, & Wong, 2016; Fankhauser, Smith, & Tol, 1999; Fenton, Paavola, & Tallontire, 2017; Howden *et al.*, 2007; Kinsey, Burger, & Gunning, 1998; McLeman & Smit, 2006). In this context, diversification emerges as an effective strategy for vulnerable HHs to manage adverse impacts on income and food security caused by extreme climatic events, uncertain agricultural production but also unexpected market shocks (Asmah, 2011; Barrett, Reardon, & Webb, 2001; Di Falco, Adinolfi, Bozzola, & Capitanio, 2014; Di Falco & Perrings, 2005; Di Falco, Veronesi, & Yesuf, 2011; Heltberg, Oviedo, & Talukdar, 2015; Morduch, 1995). However, the literature has also stressed as poorly endowed HHs can be locked-in in a diversified, but low-returns, set of activities (Lohmann & Liefner, 2009; Reardon, Taylor, Stamoulis, Lanjouw, & Balisacan, 2000).

SSA is expected to be one of the most vulnerable areas in the next decades for manifold reasons. First, in the SSA region, agriculture represents the main sector in terms of employment, with about 98% of agriculture exploiting marginal rain-fed lands (Wani S. P. & Rockstrom J., 2009). Stagnant agricultural yields and high population growth have led to a fall in per-capita food availability since the 1970s, although this was reversed with improved performance during 2000–10 (Nin-Pratt, Johnson, & Yu, 2012). However, recent increases in global food prices and climate variability have aggravated food insecurity, with consequent risks of malnutrition (INS-Niger (Institut National de la Statistique), 2015). Moreover, SSA is expected to be strongly affected by climate changes since future projections based on observed trends indicate that temperatures could rise faster than the global average increase during the 21st century (James & Washington, 2013; Joshi, Hawkins, Sutton, Lowe, & Frame, 2011; Sanderson, Hemming, & Betts, 2011). Although most areas in the African continent lack sufficient observational data to draw conclusions about trends in annual precipitation, this is also expected to change. In