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Do farmers adopt fewer conservation practices on rented land? Evidence from straw retention in China

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ABSTRACT

We examine how land tenure arrangements affect Chinese crop farmers' adoption of straw retention, a key conservation practice promoted by the Chinese government in part to curb rising air pollution. Using data from a 2016 farmer household survey covering 1659 crop plots in Henan Province in central China, we analyze whether farmers are less likely to adopt straw retention on rented plots compared to own-contracted plots. To address the potential endogeneity of the choice of renting from others, we use an instrument exploiting the role of remittance income from household members migrated to cities in a bivariate probit model and a control function approach, respectively. Our main results reveal that the Chinese crop farmers' likelihood of adopting straw retention were almost cut in half on rented plots compared to their owned plots, assuming the assumptions for biprobit or control functions hold. This suggests greater attention is needed to examine the spillovers across agricultural and environmental policies as China pushes for both a nationwide land rental market and more sustainable agricultural practices.

1. Introduction

Land tenure security is crucial in promoting the adoption of various conservation practices, including conservation tillage (Lee and Stewart, 1983; Soule et al., 2000), contour farming (Soule et al., 2000), conservation crops (Fraser, 2004), and stone terraces or soil bunds (Gebremedhin and Swinton, 2003). Arguably, more secure land tenure, which often refers to complete, permanent, or durable ownership of farmland, leads to higher willingness to adopt conservation practices, especially those practices with long-term soil fertility benefits. This is likely because greater land tenure security increases the likelihood of farmers reaping the benefits of land investments, which are often long-term (Feder et al., 1988; Soule et al., 2000; Fraser, 2004; Kabubo-Mariara et al., 2010). Despite the perceived significance of land tenure, there is a lack of evidence of the role of land tenure security in conservation practice adoptions, especially in developing countries such as China. This, in part, results from varying definitions of land tenure security and heterogeneity in the ownership and tenure systems across different countries (Kabubo-Mariara et al., 2010).

In China, land tenure security has particular relevance because, under the current Household Responsibility System (HRS), agricultural land is owned by the collectives at the village level, and each eligible farmer household is granted a land contract right to farm a village-allocated land parcel with up to 30 years of tenure (Hu, 1997). The distinct nature of rural tenure systems confronts Chinese farmers with greater land tenure insecurity, which could potentially hinder farmers' investments in production and conservation practices, especially those with a long time horizon. For instance, researchers have found that frequent land reallocation by the village collectives to accommodate a growing rural population often dampens the stability and security of land tenure, resulting in a very uncertain land tenure length with an effective length of much less than 30 years (Liu et al., 1998; Brandt et al., 2002; Tan et al., 2006).

In fact, since Jacoby et al. (2002), many researchers have examined the impacts of land tenure insecurity in Chinese farmers' production decisions, with a focus on input use such as organic fertilizer (e.g.,

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Jacoby et al., 2002), land use efficiency (Zhang et al., 2011; Leight, 2016), and forest output efficiency (Salant and Yu, 2016). In contrast, evidence of the impacts of land tenure in conservation practice adoption in China is relatively scarce. Wang et al. (2010) investigate the determinants of adopting conservation tillage as well as residue retention; however, they do not consider land tenure as a driving factor. Liu and Huang (2013) were among the first to assess how land tenure security affects conservation practice adoption and show that the ownership of land is slightly positively associated with increased likelihood of using contour cultivation.[1]

However, to the best of our knowledge, no study has explicitly modeled the role of land tenure in the adoption of straw retention, an increasingly important component of conservation practices (Pittelkow et al., 2015). Straw retention (i.e., returning straw to the field) refers to a residue management strategy of covering the crop straws on the soil surface after harvest, which has been proven to improve long-term soil productivity (Lu, 2015; Wang et al., 2015), and boost yield (Huang et al., 2013; Wang et al., 2015). However, burning straw, which generates large amounts of PM 2.5 (Tao et al., 2013; Shon, 2015; Chen et al., 2017), is still common in China and has become one of its biggest environmental problems despite increased public attention, fines, and penalties. In an attempt to reduce open burning of straw, thus curbing PM 2.5 pollution, the Chinese government has recently undertaken various measures supporting sustainable utilization of crop residues. For instance, in May 2015, the government announced a straw retention subsidy pilot project, which offered a cash payment to farmers to encourage straw retention adoption. The project was extended to all of China in 2016.[2] In addition, we analyze land tenure insecurity in the context of new policies in which China increasingly promotes rural land transfers among farmers through a land rental market. There is a lack of understanding on whether and how farmers make production and conservation decisions differently on rented land obtained through the rental market versus their own-contracted farmland allocated by collectives.

This study aims to examine whether and how land rental decisions, which are increasingly prevalent under the new rural land transfer market, affect Chinese crop farmers' adoption of straw retention. We hypothesize that Chinese crop farmers are less likely to adopt straw retention and other conservation practices on land rented from others due to their perceived less secure land tenure arrangement. We argue that farmers on rented fields face less secure land tenure due to the short-term nature of leasing contracts, and thus have lower willingness to undertake a conservation practice compared to land formally allocated to them via long-term contracts from the collectives.

To test our hypothesis, we use a 2016 rural household survey covering 1659 crop plots in Henan Province in central China and analyze whether farmers are less likely to adopt straw retention on rented plots compared to own-contracted plots. To address the potential endogeneity of the land tenure variable, we rely on an instrument that proxies the remittance income from the household members who migrated into cities. Arguably, a higher ratio of migrants' income over agricultural profits, conditional on available laborers and farmers' household income, would lead to a smaller likelihood of renting from others but not directly shift conservation practice choices. Following Wooldridge (2010), we employ both a bivariate probit and a control function approach using the above instrument to address the endogenous explanatory variable of land tenure.

Our main results confirmed that Chinese crop farmers are less likely to adopt straw retention on fields rented from others compared to own-contracted plots. In particular, the bivariate probit and control functions controlling for the endogeneity of the land tenure variable suggest that on average, the likelihood of Chinese crop farmers adopting straw retention on rented fields are almost only half compared to that for their own-contracted fields. In contrast, simple probit regressions with endogenous land tenure variable show that a rented plot is associated with an eight percent reduction in the probability of adopting straw retention after harvest throughout 2015. Overall, our results confirm our hypothesis of less conservation practice adoption given less secure land tenure arrangements, and are comparable to many studies in other countries.

This study contributes to the literature of conservation practice adoption by quantitatively examining the link between land tenure security and straw retention adoption in China for the first time. In particular, our analysis provides evidence that Chinese crop farmers are significantly less likely to adopt straw retention, a critical conservation practice, on rented plots compared to those own-contracted plots. More importantly, our research is of great policy relevance since it reveals the previously overlooked, potentially negative interconnection between two policies promoted by the Chinese government—encouraging the adoption of straw retention and expanding the rural land rental market—and offers insights into how the government can better promote and balance them. Finally, the significant larger average partial effect in the main specifications suggests that one needs to control for the endogeneity of the land tenure variable using the biprobit or control function approach.

The rest of this article is organized as follows: Section 2 provides a brief review of China's land system and the development of the land rental market. Section 3 introduces the conceptual framework. Section 4 introduces the empirical implementation strategy. Section 5 describes the data used in this study and empirical implementation. Section 6 discusses the empirical results. Section 7 provides concluding remarks.

2. Land tenure and land rental market in China

China prohibits private land ownership. The current HRS was introduced in the early 1980s and allocates a parcel of contracted farmland to each eligible rural household on the basis of household size, which is referred to as the land contract (and use) right. Nevertheless, the allocated land is owned by village collectives represented by villager committee or township government (Hu, 1997). Farmers are free to make their own agricultural production decisions, though they are not permitted to convert the land to non-agricultural use. In the early stages of HRS, land contracts only lasted for a one- or two-year period, which led to significant land tenure insecurity and discouraged farmers from making land improvements (Krusekopf, 2002). Realizing this limitation, the Chinese government lengthened the land contract terms to 15 years, further extending it to 30 years in 1993 (Zhang et al., 2011).

However, the increase in duration of land contracts did not necessarily improve the tenure security for rural households for two reasons: (a) village collectives periodically reallocate village land through administrative means to reach egalitarian goals in response to household demographic changes, even in the midst of land contract periods (Liu et al., 1998; Brandt et al., 2002; Tan et al., 2006); and (b) collective allocations efficiency is negatively impacted by an increasing number of rural migrants going off-farm and working outside the village, which tends to lead to productive inefficiency (Benjamin and Brandt, 2002).

In response to the rising need of more secure land tenure, the central government has codified a framework for the protection of land rights and development of a land rental market, including the Land

[1] Chinese farmers do not own the farmland. As will be discussed in detail later, the "ownership" of a plot by a farmer household in China is actually represented as the land contract right.

[2] The pilot project in 2015 was undertaken in five provinces—Anhui, Shandong, Hunan, Sichuan and Zhejiang. Our study analyzes crop and crop residue choices by farmers in Henan province for the 2015 growing season, which was not included in the pilot project. In addition, the progress on the subsidy project varied dramatically among different regions. Based on the experiences of our interviewers, most farmer households in Henan were not aware of this subsidy program at the time of the survey.