Biomass energy use, price changes and imperfect labor market in rural China: an Agricultural Household Model-Based Analysis

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Introduction

•Due to the limited access to advanced energy technologies and modern energy services, the rural population still depends heavily on direct combustion of traditional solid biomass (i.e. crop residues and firewood) for living in rural China.

•Under an imperfect labor market, households' consumption, production and labor allocation decisions are interlinked.

Study Objective

•To robustly investigates how price shocks potentially influence household biomass energy using behaviors under the imperfect labor market in rural China.

Conceptual Framework

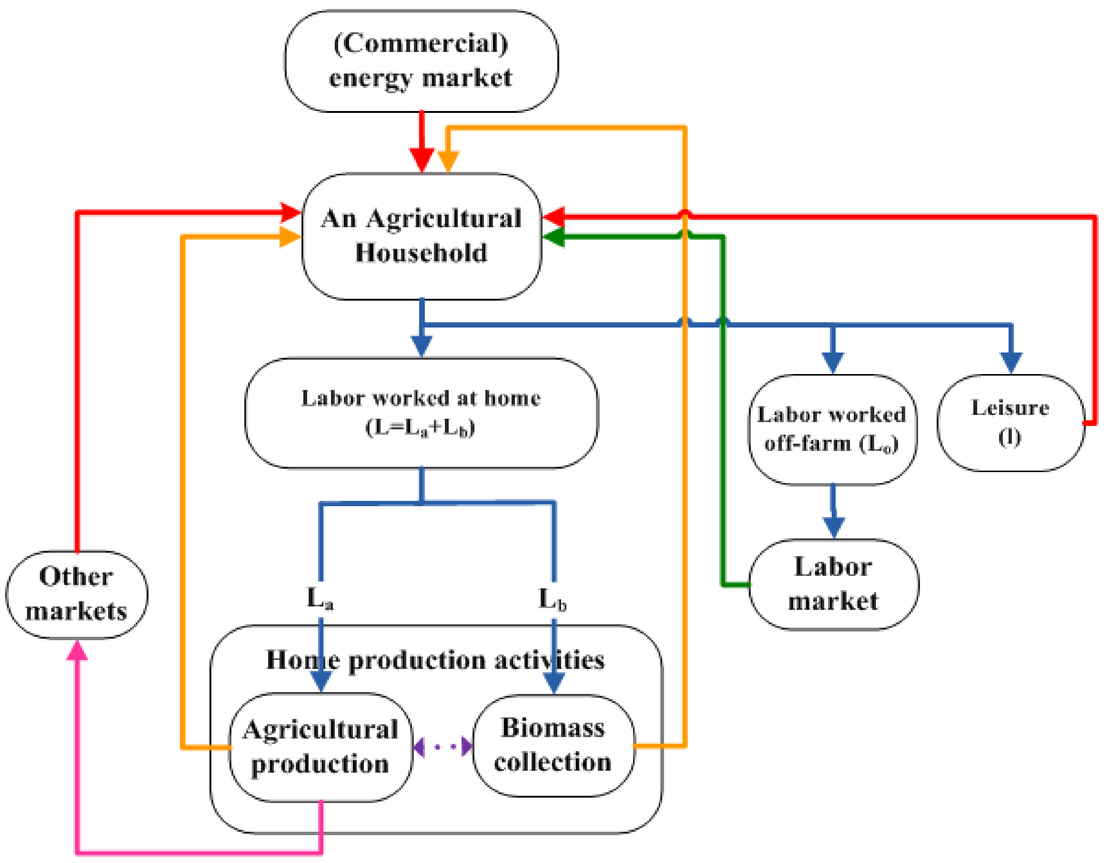

Figure 1: Conceptual framework
Source: *Author's own depiction*

Methodology

•A non-separable household model which integrates biomass collection and biomass energy consumption into the intra-household economic activities is developed.

•The total effect of price changes on household biomass energy use is (in elasticity form):

$$\underbrace{E(C_b/p_x)^G}_{\text{Total effect of price changes on household biomass energy use}} = \underbrace{E(C_b/p_x)^H}_{\text{Direct response of biomass energy consumption to a change in the exogenous prices}} + \underbrace{E(w^*/p_x)[E(C_b/w^*)^H + \theta_b S_l]}_{\text{Indirect effect via the endogenous variation in the shadow wage induced by the exogenous shock}}$$

Where, C_b is the consumption of biomass energy; p_x is exogenous market price; w^* is the shadow wage of household labor; θ_b is the full income elasticity of biomass energy consumption; and S_l is the share of leisure consumption in shadow full income (budget).

- Two-stage estimation strategy is adopted:

The shadow wage is first estimated and then used to estimate household consumption decision (LA/AIDS model) and labor demand systems (labor cost share equations) in the second stage.

- The parameters obtained from the different estimations are subsequently applied to compute the consumption and labor demand elasticities for biomass energy.

Main estimation results

Table 1.
Estimated simple price elasticities of sampled agricultural households (using mean value)

		With respect to the price of					
	Full income elasticity	Self-consumed agricultural products	Biomass energy	Commercial energy	Labor (shadow wage rate)	Other purchased goods	Labor (market wage rate)
Consumption							
Self-consumed agricultural products	2.111	-0.744	0.175	0.041	-0.008	0.640	-
Biomass energy	1.027	0.067	-0.783	0.007	0.604	0.216	-
Commercial energy	1.617	0.246	0.102	-1.163	0.396	0.530	-
Leisure	0.655	-0.001	0.096	0.004	-0.052	0.062	-
Other purchased goods	2.255	0.186	0.162	0.025	0.293	-1.177	-
Labor Demand							
Home production	-	-	-	-	-0.450	-	0.290
Off-farm employment	-	-	-	-	0.150	-	-0.186

Source: *Author's own estimation and calculation*

Table 2.
Effects of price changes on household biomass energy use

	With respect to the external price of			
	Self-consumed agricultural products	Commercial energy	Other purchased goods	Labor
The shadow wage rate $E(w^*/p_x)$	0.020	-0.133	-0.572	0.439
Consumption of biomass energy $E(C_b/p_x)^H$	0.078	0.018	0.227	0.129
Consumption of biomass energy $E(C_b/p_x)^G$	0.104	-0.157	-0.528	0.709

Source: *Author's own estimation and calculation*

Conclusions

Neglecting the indirect effects via the internal labor price changes can bias the final effect on household behaviors.

Policy Implications

- Reducing energy price by developing energy technologies and exploring more types of renewable energy sources should be attached more importance.
- Measures directed at mitigating the binding constraint imposed on off-farm employment, such as promoting education and providing more job opportunities, should be taken.
- Indirect sources of market failure also need to be eliminated by establishing a sound and effective social safety net to provide better access for rural households to public services.

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