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Policy impacts under alternative land market regimes in rural China

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1 Introduction

In the fields of agricultural and development economics, the Chinese land tenure regime continues to attract the attention of the scientific community and there is an ongoing public debate about the system and its prospects for further reform. Since the dismantling of the commune system in the 1970s and 1980s and its replacement by the so-called Household Responsibility System (HRS) (Fan et al., 2005; Huang et al., 2009), the responsibility of agricultural production has been put back into the hands of individual households. Under the current system, land is communal property and households receive land contracts for a period of 30 years. The land contracts grant the household income and control rights; however, they do not include the right to sell the land (Deininger and Jin, 2005; Heerink et al., 2007; Huang et al., 2008, 2009; Liu et al., 1998).

To ensure equal per capita access to land in the event of growing or shrinking household size, land can be reallocated by local authorities (Deininger and Jin, 2005), though the central government, in principle, seeks to restrict land reallocation by local authorities (Krusekopf, 2002) and has legally sanctioned the right of farmers to engage in land rental transactions (Feng et al., 2004, cited in Heerink et al., 2007). Nonetheless, there exists substantial heterogeneity in the implementation of this land tenure system across provinces and even within villages. In some localities, land reallocations no longer take place, while in others they still occur. Likewise, land rental markets are governed by diverse regulations, which range from free land transfers to outright prohibition (Carter and Yao, 2002; Deininger and Jin, 2005; Heerink et al., 2007; Krusekopf, 2002).

China's land market regime is potentially well-suited to promote equity objectives; egalitarian access to land fulfills an important welfare function by providing almost the entire rural population with a basic means for subsistence. Not surprisingly, it is often cited as a reason for the virtual absence of a landless class as well as a reason for the relatively high level of social development in the country (Deininger and Jin, 2005; Gulati et al., 2005). One major implication of the land tenure system, however, is that it introduces a substantial degree of tenure insecurity. Households which leave land idle, rent out land, or find off-farm employment run the risk of losing their land or receiving land of inferior quality in a future reallocation (Deininger and Jin, 2005; Kung, 2002; Shi et al., 2007; Zhao, 1999).

In spite of this tenure insecurity, a land rental market is emerging in China. While earlier studies report sluggish developments of land rental markets and low levels of land rental activities with only 1% to 3% of agricultural land being transferred via market transactions (Krusekopf, 2002; Liu et al., 1998; Yang, 1997; Yao, 2000), more recent analyses highlight accelerating trends in the emergence of land markets such as higher shares of land being rented (Heerink et al., 2007; Kung, 2002; Tu et al., 2006). In an analysis of data from three provinces, Deininger and Jin (2005), for example, find that by the end of the 1990s the area of land allocated via market mechanisms already exceeded the area which has been reallocated administratively. The authors also find that just 16% of villages were using restrictions on land transactions. Land transfer activities, however, vary widely between villages (Krusekopf, 2002).

An underlying objective of the land regime – namely, to ensure an egalitarian distribution of land – has resulted in very small land holdings with average land endowments typically not exceeding one mu per capita.¹ Furthermore, reallocations and the principle that households should receive land of the same quality have resulted in a large degree of land fragmentation (Gulati et al., 2005; Heerink et al., 2007).

Both the insecure character of land tenure and the structure of the land holdings are widely regarded as having substantial consequences for productivity and efficiency. Because of partial restrictions on land rentals and underdeveloped land markets, the scope for a consolidation of the land holdings into larger operations is limited. This, in turn, limits the possibility to exploit

¹ One mu roughly corresponds to 1/15 of a hectare.

economies of scale and improve the competitiveness of the agricultural sector (Carter et al., 2009). An econometric study of farm productivity carried out by Benjamin and Brandt (2002), for example, finds a significant relationship between farm size and labor productivity, pointing towards possible efficiency losses due to the current character of the land tenure system. According to Carter and Yao (2002), restricted land transfer rights constrain efficient allocation of labor in rural areas. Heerink et al. (2007) detect reduced efficiency of input-use because of small and fragmented plots and Rozelle et al. (1998) find negative impacts of tenure insecurity on input use and production in agriculture. Deininger and Jin (2005) observe a correlation between the dispersion of agricultural ability among farmers and the functioning of land markets: farmers are more homogenous with respect to their farming abilities in areas with more active land markets, which according to the authors provides evidence of a more efficient allocation of land via market mechanisms. In general, the mechanism of administrative land allocation is considered to be too inflexible and little capable of transferring land in an efficient manner (Deininger and Jin, 2005; Krusekopf, 2002). Finally, tenure insecurity is associated with reduced levels of long-term private investments in land (Wu et al., 2005), such as investments in land improvement or irrigation systems. This too has consequences for productivity.

Of particular relevance for the Chinese economy are also the consequences the land tenure regime has on the mobility of labor between different sectors of the economy, especially rural-urban migration. Two characteristics of the land tenure arrangements are of particular importance for rural-urban migration. First, because of the possibility of reallocations of land by village authorities, households run the risk of losing their land entitlements once they engage in off-farm activities. In fact, there is evidence that off-farm employment is a significant factor for land reallocation and has negative impacts on the amount of land allocated to a household who has or does engaged in off-farm employment (Benjamin and Brandt, 2002; Lohmar, 1999; Yang, 1997). Second, underdeveloped land markets and the impossibility of selling land deprive farmers the opportunity to receive the discounted value of future income streams generated from selling their land (Yang, 1997). Hence, farmers may be unwilling to find off-farm employment, let alone abandon agriculture entirely (Shi et al., 2007; Taylor et al., 2003). In the particular case of rural-urban migration, China's land tenure arrangements are cited as a reason why migration of the rural population to cities during China's economic development has been relatively limited compared to other countries. Migration in China remains temporary and levels of non-agricultural employment in rural areas are comparatively high (Fleisher and Yang, 2006; Yang, 1997; Zhao, 1999).

Finally, the land market regime may have implications for inequality at the level of rural communities. In a situation in which land reallocation is no longer carried out by local authorities, demographic change in households may cause land distribution to become increasingly unequal. In a village level study in Guizhou province, Xing et al. (2009) find that contract land per capita is the largest contributing factor to overall village inequality. In this context, well-functioning land markets may also allow non-migrating households to benefit from increasing migration wages because in a market setting this would lead to a higher supply of land from migrating households and a decrease in land rental rates.

A popular position among scholars of land issues in China is that more secure property rights and the existence of well-developed land markets would solve many of the problems described above by increasing the efficiency of land allocation, supporting economies of scale in agricultural production, helping raise farm investments, increasing rural labor mobility, and facilitating the permanent transfer of labor from agriculture to the non-farm sector and to urban areas (Carter et al., 2009; Deininger and Jin, 2005; Kung, 2002; Shi et al., 2007). There are, however, concerns that further rural land reform may jeopardize the social security function fulfilled by land and pose challenges to social stability (Huang et al., 2008; Tao and Xu, 2007). It is also emphasized that the potential benefits of such a reform may be contingent on the establishment of an effective system of social protection which covers both rural and urban areas (Carter et al., 2009). That said, strengthening property rights might not be sufficient for establishing well-functioning land markets. Instead, the presence of opportunities for off-farm

employment and a well-functioning labor market may also play an important role (Deininger and Jin, 2005).

This paper contributes a new village-level perspective to the current discussion. An equilibrium model of a village economy in Guizhou province is applied to analyze the impacts of trade reform at the rural household level and the village level. Two alternative land market regimes are distinguished to shed light on the effects of different land tenure arrangements on the outcome of policy reforms. Due to its importance for individual households and for the Chinese economy as a whole, special emphasis is put on the modeling of migration. Welfare and equity concerns raised in the debate are addressed by explicitly considering poverty and inequality. Thereby, to the knowledge of the authors, this is the first simulation analysis which allows for the assessment of the interplay between land market arrangements, labor migration, poverty, and inequality at the micro-level in China.

2 Methodology

2.1 Research Area

At the focus of the analysis is a rural community located in Puding County in the Chinese province Guizhou. The data used for the study stems from a rural household survey carried out in 2007 in the scope of a research project on rural poverty in China by the International Food Policy Research Institute (IFPRI), the Chinese Academy of Agricultural Sciences (CAAS), and Guizhou University (Brown et al., 2010; Xing et al., 2009). The survey took 2006 as a reference year and covered all households in the selected administrative village which consists of 11 natural villages with 257 households. Each household in the village has, on average, 3.72 mu of agricultural land of which about 92% is non-irrigated. Annual net income reached 1,464 Yuan per adult equivalent in 2006. Based on the average consumption expenditure per capita and a poverty line of 892 Yuan per capita,² the poverty headcount is 0.45, the poverty gap index is 0.11, and the poverty severity index is 0.04. The Gini coefficient on consumption expenditure was 29.4% in 2006.

About 61% of household income in the village stems from agricultural production. Table 1 illustrates the high importance of migration as a livelihood strategy. Income from remittances is 13% of total household income and represents, on average, the third most important item in the income portfolio. Moreover, it constitutes the second most important source of cash income to the village, following sales of rapeseed. The high contribution of remittances to household income also reflects the high share of migrants in the population: about 21% of the working age population migrated in 2006 and 50% of households had at least one migrant. Apart from remittances, income from off-farm employment stems from seasonal employment which comprises irregular agricultural and non-farm jobs, accounting for 9% of total income on average. Wage work, i.e. employment as a government official, teacher, or at a state-owned, collective, or private company, contributes 1% to total household income on average. Self-employment contributes 1% only to overall household income.

In the village, land has not been reallocated since rural reforms in the early 1980s (Xing et al., 2009). Moreover, a certain degree of land rental activities can be observed. As Table 2 shows, households reported 58 land rental transactions in 2006. This means that about 23% of households were involved in land rentals that year. According to the table, most land rented is non-irrigated. Only seven of the 58 households which report having rented or rented out land have done so with irrigated land. Furthermore, the table reveals a large discrepancy between the number of households renting land (47) and those renting out land (11). The main explanation for this observation is that much of the land rented may come from households which had migrated to other parts of the country. As these households were absent at the time of the survey, land rented out by them is not recorded. A further important result is that 90% of land rental transactions take place within the 11 natural villages. Although the corresponding information is unavailable, most

² This poverty line corresponds to a daily consumption allowance of US\$ 1.08.

transactions from or to places outside the natural village, can be assumed to occur within the administrative village.

Table 1: Composition of Household Income.

	Share in total value
Agricultural income	0.61
Crops	0.49
Livestock	0.12
Other produced	0.04
Non-agricultural income	0.39
Employment	0.24
Wage employment	0.01
Seasonal employment	0.09
Self-employment	0.01
Remittances	0.13
Other sources	0.15
Total	1.00

Table 2: Location of Land Rentals (Absolute Number of Transactions and Shares of Locations in Total Transactions).

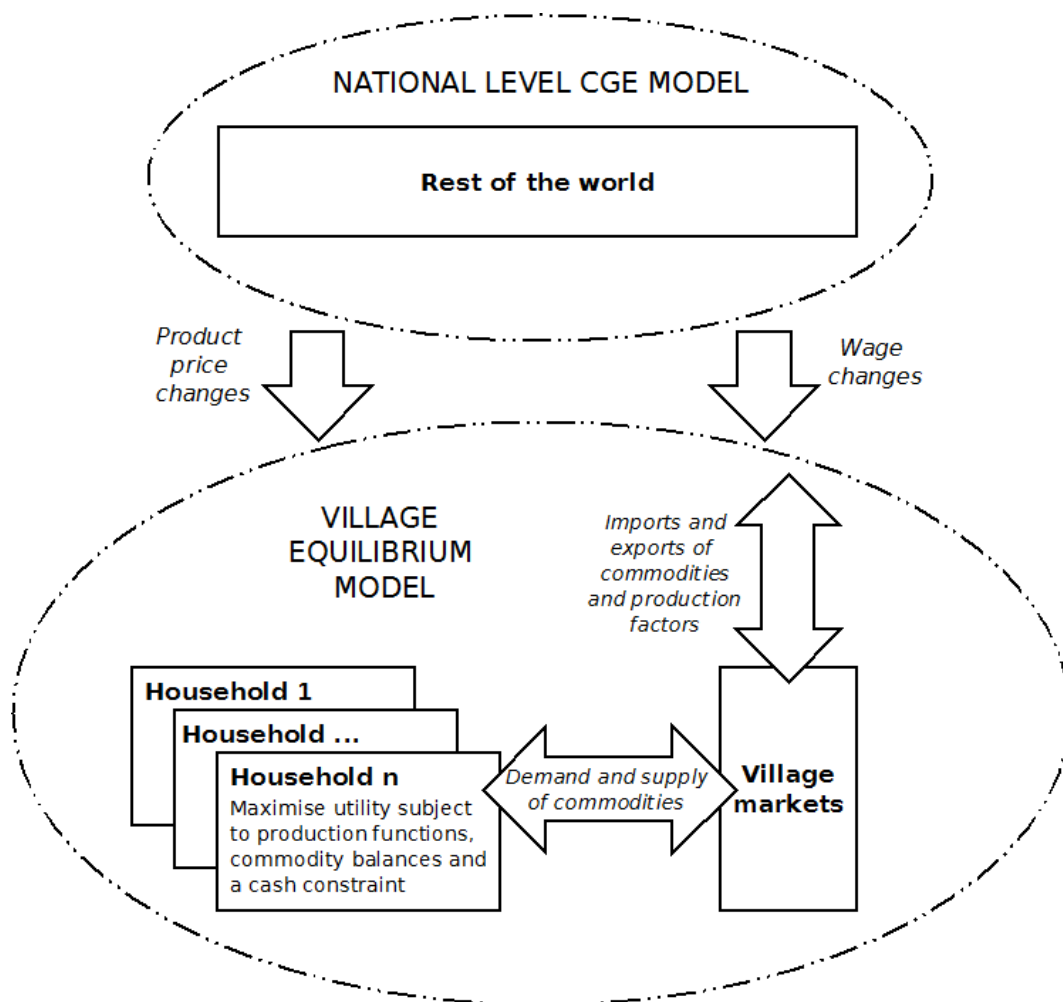
		Location		Total
		Within the natural village	Outside the natural village	
Irrigated land	Rent in	3	2	5
		0.6	0.4	
	Rent out	2	0	2
Non-irrigated land		1.0	0.0	
	Rent in	39	3	42
		0.9	0.1	
	Rent out	8	1	9
		0.9	0.1	
All land transactions		52	6	58
		0.9	0.1	

2.2 Modeling Approach

To assess village level impacts of a trade reform scenario under different land market regimes, a price and wage shock obtained from a national level CGE simulation is administered to a village computable general equilibrium (CGE) model. The overall modeling framework is depicted in Figure 1. The bottom part of Figure 1 offers a schematic overview of the village CGE model. The village consists of representative households which demand and supply commodities in village markets.³ Village surplus is exported from the village and anything the village cannot provide on its own in sufficient amounts is imported. Household and village level market balances constitute the general equilibrium framework of the model. Depending on whether a commodity is not tradable at the household level (hereafter, “non-tradable”), village non-tradable, or village tradable, the general equilibrium framework determines the level of price formation: within the household, at the village level, or in the rest of the world. In the latter case, the price level is exogenous to the village (Taylor and Adelman (1996)).

³ Here, the term “commodities” refers to both goods and factors which comprise of intermediate inputs, produced outputs, manufactured consumption goods, as well as land and labour.

The equilibrium framework connects a number of agricultural household models, constituting the basic building blocks of the village model. Agricultural household models are extensions of the basic model proposed by Singh et al. (1986) and define the behavior of each of the six representative household groups (RHG). Households maximize utility subject to production functions, commodity balances, and their cash income constraint. Each household can have a maximum of four activities: agriculture, formal and informal local off-farm work, and migration. Agricultural production is modeled with a nested Leontief-Cobb-Douglas technology (Löfgren et al., 2002). Household consumption is represented by a per capita linear expenditure system LES which includes self-consumed agricultural output, purchased goods, and leisure. The models take into account non-separability of households' production and consumption decisions. Non-separability stems from two sources: first, family labor and hired labor are assumed to be imperfect substitutes in agricultural production; and second, utility considerations are taken into account in the modeling of households' decisions on the supply of labor to local off-farm employment as well as to migration.



Source: Adapted from Kuiper (2005).

Figure 1: Village Equilibrium Model in a Macro-Microsimulation Framework.

The approach to modeling household labor allocation takes into account household preferences towards work in different types of employment as well as feedback links between household migration and consumption demand, thus incorporating developments made by Lopez

(1984,1986) and Wouterse (2006) into the standard model of Singh et al. (1986). This approach offers the possibility to model migration responses, taking into account factors which may influence the household's flexibility to respond to changes in incentives to migrate. Moreover, this approach makes it possible to incorporate supply-side related differences in migration responses between households arising from differences in socio-economic characteristics. The approach used in this study is a methodological novelty and contributes a refined treatment of migration to the literature on micro-level simulation models.

In the analysis, this new approach is exploited through the stratification of the RHG. The RHG stratify the village population according to households' demographic characteristics and income levels. Regarding the former, households are divided into two groups along the median of the dependency ratio. Following the assumption that households with a relatively high share of dependants are less flexible in their migration responses, this procedure yields two aggregate representative households with different migration behavior, namely an "inflexible migration" household with weak migration capabilities and a "flexible migration" household with stronger migration capabilities. Thus, the influence of household demographics on labor allocation behavior is implicitly modeled. The two migration groups are further subdivided according to income terciles, allowing the assessment of different policy impacts on poorer and richer households.

The model allows for two land market regimes, represented by two different land market closures. Under the first closure, the amount of land used by the households is fixed and for each RHG an internal land balance is established under a household specific shadow price for land. Under the second closure, a perfectly neoclassical village land market is assumed. It is possible for households to trade land on a village land rental market. Supply and demand of land are reconciled within the village and a uniform land rental rate arises.

Compared to reality, the assumptions brought forward by the land market closures of the model are simplifying. Land transactions occur in reality, but within an institutional framework. This prevents the emergence of a land rental market which could, at the least, approximately be labeled as perfect. This is also reflected in the fact that land is still not traded to a large extent. Furthermore, instead of a uniform village land rental rate, observed land leases involve a high range of prices and even include a considerable number of gratis transactions. Hence, rather than occurring in one of the two market regimes – the complete absence of a land market or the perfect market – land transactions follow more complicated arrangements driven by the institutional framework of China's land tenure regime. Thus, land market regimes in the model represent the extreme ends of a gradient on which the reality lies somewhere in between.

The model is built upon a village social accounting matrix (SAM) created from the household data introduced above. Details of the model can be found in the Annex to this paper.

3 Scenario and Simulations

For the policy simulations, price and wage changes following unilateral trade liberalization by China obtained from a national level CGE simulation are fed as a shock into the village model. These price and wage changes are taken from a study conducted by Zhai and Hertel (2010) which employs a comparative static CGE model for the Chinese economy. This study is part of a recent undertaking to analyze the impact of trade liberalization on inequality and poverty (Anderson et al., 2010).

The policy scenario analyzed involves the unilateral elimination of all import tariffs and export subsidies in the agricultural sector and lightly processed food sector as well as the elimination of import tariffs in all other sectors. In the base situation, the overall level of protection is low: with average applied tariff rates of 6.5% and 5.0%, respectively, the agricultural and the food manufacturing sectors receive the highest levels of protection in terms of tariffs in the base situation. Average tariffs applied to other sectors are consistently lower, ranging between 0.0% and 2.9%. Exports subsidies are in the agricultural sector only, with an average rate of 0.8%. This initial structure of protection leads to relatively modest price impacts of

liberalisation, with prices and wages declining across the board and more negative effects on the agricultural and food sectors (Zhai and Hertel, 2010). Table 3 presents the price and wage shock which has been constructed from the simulation results obtained by Zhai and Hertel (2010) and which constitutes the policy scenario to be analyzed with the village model.

Table 3: Price and Wage Effects of Unilateral Trade Liberalization in China.

	% change
Activity prices	
Agriculture	-1.79
Formal local off-farm work	-1.03
Informal local off-farm work	-1.32
Migration	-1.17
Intermediate input prices	
Capital	-1.28
Imported labor	-1.80
Services	-0.52
Consumer prices	
Own-produced food	-1.79
Food of plant origin	-1.26
Other food	-1.81
Non-food	-0.83
Services	-0.66

Source: Zhai and Hertel (2010); Zhai (2011); own calculations.

Reflecting the relatively high level of protection in the base period, agricultural production is affected most adversely among the three activities. The price of this activity, i.e. the aggregate price of agricultural output, deteriorates by 1.79%. Activity prices in the off-farm activities, i.e. wages, decline less. Wages in formal and informal local off-farm work decline by 1.03% and 1.35%, respectively. Payments to migration workers decrease by 1.17%. Intermediate input prices are lowered by -0.50% to -1.80% after the trade reform. The strongest decline is in the price of village imported labor, which is the wage for unskilled agricultural labor. The decrease in consumer prices is between -0.66% in case of services and -1.81% for purchased food not of plant origin. The price for own-produced food is assumed to be the same as the agricultural output price, reflecting the opportunity cost of self-consumption. Although stemming from a specific policy reform, this scenario which found an increase in migration wages relative to agricultural output prices can be taken as an example of a more general scenario involving improved incentives to work in the non-agricultural sectors of migrant destinations.

To assess the impact of the policy reform under different land market regimes, the scenario is simulated twice. In the first simulation, land market closure is used. This simulation therefore assumes land to be non-tradable. In the second simulation, a village land rental market is allowed. By taking the first simulation as the counterfactual for the second, the comparison of the two simulations yields insights into the possible effects of a land rental market on the outcome from trade liberalization for individual households as well as the entire village.

4 Results

Village Level Impacts

Table 4 presents the aggregate impacts of the simulated policy reform on village exports and imports. Overall, the effects of the policy shock are moderate. However, the existence of a land market leads to considerable differences in some outcomes. As would be expected based on the structure of the relative price and wage changes fed into the village model, the village as a whole increases migration and sends less labor to formal and informal local off-farm labor markets. Surprisingly, exports of agricultural outputs increase in spite of falling farm prices. This

phenomenon, however, is not merely the result of higher outputs from farm production in the village, but stems from an average increase in marketed surplus (Table 6). The differences between the two land market regimes are particularly pronounced for migration and exports of agricultural outputs. While exports of migrant labor increase by 0.28% after the trade reform, they increase 0.20% without a land market. In case of agricultural output, village exports increase by 0.26% with a land market. This is substantially lower than the increase which would occur without a land market, 0.46%. These differences in outcomes for migration and agricultural exports reflect the effect of stronger household specialization made possible by the land market. Moreover, although the picture at the level of individual households is different from that of the village as a whole migration increases more than the supply of agricultural products which contrasts with the situation without a land market. This corresponds to a priori expectations as it is in accordance with agricultural prices declining stronger than migrant wages.

Table 4: Policy Impacts on Village Trade (Quantities, % Change against Baseline).

	Land market closure:	No land market	Land market
Exports			
	Migrant labor	0.20	0.28
	Formal local off-farm labor	-0.01	-0.01
	Informal local off-farm labor	-0.55	-0.54
	Agricultural outputs	0.46	0.26
Imports			
	Capital intermediates	-0.08	-0.29
	Imported labor	-0.06	0.20
	Food of plant origin	-0.24	-0.23
	Other food	0.00	0.00
	Non-food	-0.91	-0.90
	Services	-1.08	-1.12

On the import side, substantial differences between the two land market regimes can be found with respect to the commodities used as intermediate inputs. While imports of capital intermediates decrease by 0.08% in the situation without a land market, they decrease by 0.29% with a land market. This is caused by the reduction in demand for this input from high and low income households in the flexible migration group, which overcompensates the increase in demand by the remaining households. The same effect occurs for services.

Interestingly, village imports of farm labor increase with a land market, although relative changes in demand for this input at the household level are the same as they are for capital and services. This result is related to the fact that high and low income households in the flexible migration group contribute the lowest amounts of labor to the village level aggregate of imported labor. Therefore, the reduction in demand by these households has a lower weight in the village and imports increase. The reduction observed in the situation without a land market is therefore reversed. As for capital and services, differences in import changes are less pronounced.

The development of imports of consumption commodities reflects changes in consumption demand. Imports of food of plant origin, non-food commodities, and services decline 0.23% to 1.12% in both land market regimes. Imports of other food remain constant. As differences in changes in consumption demand are small between the simulations for the two land market regimes, changes in imports are also virtually the same.

Changes in village exports and imports hint towards adjustments at the level of the households in the village in terms of production activities, consumption, and income levels. Table 5 presents the consequences of the latter, summarizing village level impacts on income, poverty, and inequality. In both simulations, the policy reform has slightly negative effects on total village income. The effect of the land market is almost the same under both regimes: income decreases by 1.39% and 1.38% without a land market and with a land market, respectively. Moreover,

poverty impacts of trade reform are identical in both situations. In case of inequality, as measured by the Gini coefficient, differences between the land market regimes have a weak but perceivable impact. In the situation with a land market, the inequality enhancing effect of trade reform is somewhat dampened. The Gini coefficient rises from 24.410% to 29.466%, which is lower than the increase to 29.493% obtained without a land market.

Table 5: Policy Impacts on Village Income, Poverty, and Inequality.

Scenario: Land market closure:	Base	Trade reform	
		No land market	Land market
Total village income^a	0.00	-1.39	-1.38
Poverty indices			
Poverty headcount ratio	0.447	0.449	0.449
Poverty gap index	0.105	0.107	0.107
Gini coefficient %	29.410	29.493	29.466

^a % -change against baseline.

Household Level Impacts

As Table 6 shows, village level impacts mask substantial differences in the reactions of the different household groups to the policy shock. The table presents the simulation results for the household level impacts of the policy changes on factor allocation, input use, outputs, and marketed surplus. The upper part of the table contains results from simulations with a land market and the lower part of the table contains results from simulations without a land market.

According to the upper part of the table, changes in relative prices caused by the policy reform cause migrants from households in the inflexible migration group to return to the village. These households reduce the time worked in migration by 0.16% to 0.22%. Households in the flexible migration group migrate more. High and middle income households show slightly positive migration responses, with increases in the time worked in migration by 0.06% and 0.03%, respectively. Low income households in the flexible migration group respond strongly to the relative increase in the migration wage, allocating 2.83% more time to this activity.

Four of the six household groups, namely household groups in the inflexible migration group and middle income households in the flexible migration group, use more land following trade reform. The two remaining household groups reduce the area farmed. Those which increase their land use also work more on-farm or reduce the time worked less than in the situation without the land market. This reaction, however, occurs at the expense of local off-farm activities and/or migration, as the time worked in these activities declines more than before trade liberalization.

Why do particular households use less or more land after the trade reform? Well, the explanation involves changes in shadow prices for land in the situation without a land market, as shown in Table 7. The bottom part of that table reveals two important points:

- The two household groups which make land available to other households have relatively large decreases in their shadow prices. This reflects an implicit and relatively strong reduction in demand for land.
- The decline in the shadow prices of the remaining four household groups, in contrast, is lower. The consequence is that as soon as land can be traded on the market, a uniform land rental rate arises within the village. This land rental rate is, as the upper part of Table 7 shows, higher than the shadow prices for land for high and low income households in the flexible migration group in the situation without a land market and lower than the shadow prices for land for remaining households. Hence, the former make land available to the latter.

Table 6: Policy Impacts on Household Production (% Change against Baseline)

Land market closure:		Land market					
Migration group:		Inflexible migration			Flexible migration		
Income level:		High	Middle	Low	High	Middle	Low
Factor allocation and input use							
Migration		-0.22	-0.22	-0.16	0.06	0.03	2.83
Formal local off-farm		-0.01			-0.01		-0.01
Informal local off-farm		-0.55	-0.55	-0.61	-0.48	-0.58	-0.60
Agriculture							
Labor		-0.18	0.08	2.12	-3.19	0.15	-2.35
Land		0.36	0.70	3.30	-3.58	0.70	-1.19
Intermediate inputs		0.27	0.56	3.07	-3.51	0.59	-1.43
Activity output							
Agriculture		0.27	0.56	3.07	-3.51	0.59	-1.43
Marketed surplus							
Agriculture		0.76	1.54	6.31	-5.03	1.35	-1.40

Land market closure:		No land market					
Migration group:		Inflexible migration			Flexible migration		
Income level:		High	Middle	Low	High	Middle	Low
Factor allocation and input use							
Migration		-0.22	-0.20	-0.05	-0.07	0.02	2.29
Formal local off-farm		-0.01			-0.01		-0.01
Informal local off-farm		-0.55	-0.54	-0.55	-0.54	-0.57	-0.61
Agriculture							
Labor		-0.36	-0.27	0.05	-0.66	-0.21	-1.39
Land		-	-	-	-	-	-
Intermediate inputs		-0.06	-0.06	0.01	-0.12	-0.21	-0.29
Activity output							
Agriculture		-0.06	-0.06	0.01	-0.12	-0.04	-0.29
Marketed surplus							
Agriculture		0.28	0.55	1.02	0.39	0.45	0.26

Table 7: Policy Impacts on Endogenous Prices (% Change against Baseline).

Land market closure:		Land market					
Migration group:		Inflexible migration			Flexible migration		
Income level:		High	Middle	Low	High	Middle	Low
Endogenous prices							
Family labor & leisure		-2.05	-1.97	-1.45	-2.96	-2.04	-1.42
Land		-2.58	-2.58	-2.58	-2.58	-2.58	-2.58
Land market closure:		No land market					
Migration group:		Inflexible migration			Flexible migration		
Income level:		High	Middle	Low	High	Middle	Low
Endogenous prices							
Family labor & leisure		-2.20	-2.24	-2.40	-2.12	-2.31	-1.25
Land		-2.55	-2.50	-2.36	-2.77	-2.52	-2.62

Table 8: Policy Impacts on Land Rentals (Quantities, % Change against Baseline).

Migration group: Income level:	Inflexible migration			Flexible migration		
	High	Middle	Low	High	Middle	Low
Net land rentals						
Net area rented	4.54	-	-	-46.60	5.09	-36.78
Net area rented out	-	-95.10	-70.01	-	-	-

Adjustments in land use by households result in changes in land rentals. This is depicted in Table 8. High income households in the inflexible migration group who rented in land in the initial situation, increase rentals by 4.54%. Similarly, middle and low income households in this same inflexible migration group rent out less land after trade liberalization, reducing the area rented out substantially by 95.10% and 70.01%, respectively. Middle income households in the flexible migration group, which also increases its land use, rents in 5.09% more land. The land demanded by the four household groups mentioned is matched by increases in the supply of land by high and low income households in the flexible migration group, which reduce the area they rent.

Regarding changes in output, presented in Table 6, because labor use is identical to the activity output produced, figures for off-farm activities correspond to those on input use. Changes in agricultural production reflect the adjustments in land use and therefore differ substantially between the two simulations. High and low income households in the flexible migration group both reduce their levels of output 3.51% to 1.43% with a land market as compared to reductions between 0.12% and 0.29% without a land market. Households using more land after the reform produce between 0.27% and 3.07% more agricultural commodities, which means a reversal in sign for three household groups and a substantial increase for all households when compared to the results without a land market.

Changes in marketed surplus of agricultural products as reported in Table 6 also reflect the effect of the land market. Because in most cases marketed surplus is only a fraction of output, these changes are more pronounced than changes in output. Households with increased outputs increase their marketed surplus by higher margins than without a land market. High and low income households in the inflexible migration group no longer increase their marketed surplus as was the case in the situation without a land market and instead reduce their sales.

Impacts of the policy scenario on income, expenditure, and welfare for each household group for the two closures of the land market regime are presented in Table 9. Focusing on the upper part of the table, households experience losses in net income by 1.14% to 1.77%. Flexible migration households have higher losses on average, as they tend to substitute the migration activity with relatively low monetary returns for agriculture with higher returns. Furthermore, those with low income tend to be affected more negatively by the reform in terms of relative income losses. This is mainly a consequence of the contraction of farm incomes, which weighs more heavily for this group due to their higher shares of agricultural income in the initial situation. Compared to the effects of trade reform on net income in a situation without a land market, four out of the six household groups lose less, whereas two groups have more pronounced income reductions. This latter observation can be directly traced to the existence of the land market. The two household groups which have higher income losses than in the situation without a land market, i.e. high and low income households in the flexible migration group, reduce the area they use for agricultural production (see Tables 6 and 7). This leads to comparatively high decreases in income from farming and ultimately also to the observed higher losses in net incomes. Even the fact that the two household groups have lower reductions in remittances and informal off-farm income compared to the situation without a land market cannot compensate for these losses.

Table 9: Policy Impacts on per Capita Income and Expenditure (in Value Terms, % Change against Baseline).

Land market closure:		Land market					
Migration group:		Inflexible migration			Flexible migration		
Income level:		High	Middle	Low	High	Middle	Low
Income							
Net income		-1.14	-1.39	-1.54	-1.41	-1.44	-1.77
Remittances		-1.40	-1.39	-1.34	-1.11	-1.21	1.63
Formal off-farm		-1.04			-1.04		-1.04
Informal off-farm		-1.87	-1.87	-1.92	-1.79	-1.90	-1.91
Agriculture		-2.51	-2.43	-1.99	-3.27	-2.43	-2.82
Expenditure							
Consumption expenditure		-1.31	-1.49	-1.63	-1.58	-1.62	-2.00
Household welfare							
EV (Yuan per capita)		-2.22	-1.89	0.64	-6.06	-1.90	-3.73
EV (% of initial expenditure)		-0.04	-0.08	0.05	-0.12	-0.07	-0.27
CPI ^a				-0.86			

Land market closure:		No land market					
Migration group:		Inflexible migration			Flexible migration		
Income level:		High	Middle	Low	High	Middle	Low
Income							
Net income		-1.14	-1.42	-1.73	-1.32	-1.46	-1.69
Remittances		-1.39	-1.37	-1.22	-1.24	-1.16	1.09
Formal off-farm		-1.04			-1.04		-1.04
Informal off-farm		-1.86	-1.85	-1.87	-1.88	-1.88	-1.92
Agriculture		-2.55	-2.50	-2.36	-2.77	-2.52	-2.62
Expenditure							
Consumption expenditure		-1.32	-1.52	-1.84	-1.48	-1.65	-1.91
Household welfare							
EV (Yuan per capita)		-2.55	-2.50	-2.36	-2.77	-2.52	-2.62
EV (% of initial expenditure)		-0.05	-0.11	-0.18	-0.06	-0.09	-0.17
CPI ^a				-0.88			

^a Average value for all households.

In case of remittance income, households in the inflexible migration group as well as middle income households in the flexible migration group have to accept losses which are higher than they would be without a land market. Overall, these losses range between -1.21% and -1.40%. High and low income households in the inflexible migration group, in contrast, have larger amounts of remittances with a land market compared to the situation without a land market. Remittances in high income households decrease by 1.11% with a land market, while they decrease 1.24% without a land market. Low income households receive 1.63% more in remittances with a land market which is more than the 1.09% increase without a land market.

Examining changes in agricultural income confirms that this pattern is related to the possibility of trading land on the village market. Households with higher reductions in remittances have lower losses in farm incomes (and vice versa) in the situation with a land market compared to that without a land market. This stems from stronger reductions in the involvement in off-farm activities and from lower reductions of the time worked in agriculture by these households. These effects, in turn, are rooted in an expansion of land use (Tables 6 and 7).

In summary, the existence of a land market has a perceivable impact on the relative income changes experienced by the different households due to trade reform. Thereby, the land market allows the households of the inflexible migration group as well as middle income household of the flexible migration group to focus more on agriculture by using more land. In comparison with

the situation without a land market, the consequence is lower reductions in farm incomes, but higher losses in off-farm incomes for these households. Other households withdraw from agriculture and place more emphasis on migration and local off-farm employment. This results in lower reductions in income from these activities for these households, but also stronger declines in farm income. As the former, however, are not sufficient to compensate for the latter, the net income effects of trade reform for them is more negative in the situation with a land market.

The decreases in consumption expenditure follow the pattern of the changes in net income. After reform households spending on consumption decreases by between 1.31% and 2.00%. This decline is higher for flexible migration households than it is for inflexible migration households. According to the high reductions in net incomes (relative to the CPI), the welfare outcome of the reform is negative for five of the six household groups. The EV in absolute terms ranges between positive 0.60 Yuan per capita for low income households in the inflexible migration group and negative 6.06 Yuan per capita for high income households in the flexible migration group. Relative to initial levels of per capita expenditure, welfare losses of the households are between -0.04% and -0.27%. The welfare gain of low income households in the inflexible migration group is 0.05% of initial expenditure.

Compared to the situation without a land market, differences in welfare impacts (expressed by the absolute as well as the relative EV) between households are more pronounced in the situation with a land market. The pattern observed that poorer households tend to lose out more in relative terms vanishes in the situation without a land market. Rather, the four household groups which manage to at least partly mitigate losses in farm income by using more land also have smaller welfare losses than in the situation without a land market and some even have gains. In contrast, the two household groups which reduce their land use incur higher losses in farm income and therefore also higher reductions in net income, thereby making them worse off.⁴

Table 10 illustrates how household consumption is affected by trade liberalization under the different land market assumptions. As the upper part of the table shows, the effect of lower expenditures prevails over the effect of lower consumer prices for all households in case of own produced food, purchased food of plant origin, non-food products, and services. That means that for these products, the decline in income leads to a reduction in consumption levels. Consumption of own produced food contracts by between 0.81% and 1.49%. Demand for food of plant origin declines by between 0.07% and 0.53%. Moreover, between 0.58% and 1.72% less non-food items are consumed. Regarding services, households reduce their purchases of services between 0.79% and 1.15%.

In response to a relative decline of the prices for labor, three of the six household groups substitute towards the consumption of leisure and increase the time spent at home by 0.11% to 0.95%, thus decreasing their total labor supply. Low income households and middle income households in the inflexible migration group, in comparison, spend more time working due to shrinking incomes.

The differences between the two simulations generally follow the pattern of the differences in income changes. This pattern, however, is not maintained in case of leisure. Here, shadow wages also matter. As the possibility to trade land in the situation with the land market compared to the situation without the land market allows households to reduce less the time worked in agriculture or allows them to spend more time on-farm, the decline in the shadow wage is weaker for households which expand their land use (Table 7). Hence, the increase in the consumption of leisure is weaker than or even reversed. The two households which make land available, in comparison, have stronger decreases in the shadow wage with a land market and therefore

⁴ At first sight, it may not be intuitive that households are worse-off in terms of income and welfare with a functioning land market, i.e. in a situation with more options to maximize profits and utility. This behaviour can be explained by considering disutility aspects in labour allocation choices. In fact, if households' initial utility functions are recovered from the calibrated parameters and if values for utility are calculated from these functions, the two household groups which reduce their land use and migrate more have higher utility levels if a land market exists. This also suggests that the EV as used in the current analysis does not capture all welfare impacts of trade reforms and perhaps should be modified to include the utility connotations which are attached to labour market participation.

increase their leisure consumption more (or reduce it by a lower extent) compared to a situation without a land market.

Table 10: Policy Impacts on Household Consumption (Quantities, % Change against Baseline).

Land market closure:		Land market					
Migration group:		Inflexible migration			Flexible migration		
Income level:		High	Middle	Low	High	Middle	Low
Household consumption							
Own produced food		-0.81	-1.03	-1.18	-1.01	-1.15	-1.49
Food of plant origin		-0.07	-0.22	-0.32	-0.21	-0.30	-0.53
Other food		0.17	-0.01	-0.13	0.00	-0.11	-0.38
Non-food		-0.58	-0.94	-1.20	-0.92	-1.16	-1.72
Services		-0.79	-1.18	-1.45	-1.15	-1.41	-2.01
Leisure		0.50	0.11	-0.53	0.95	-0.01	-1.00
Land market closure:		No land market					
Migration group:		Inflexible migration			Flexible migration		
Income level:		High	Middle	Low	High	Middle	Low
Household consumption							
Own produced food		-0.81	-1.04	-1.32	-0.96	-1.17	-1.42
Food of plant origin		-0.07	-0.23	-0.41	-0.17	-0.31	-0.48
Other food		0.16	-0.02	-0.24	0.05	-0.13	-0.33
Non-food		-0.58	-0.97	-1.43	-0.82	-1.19	-1.60
Services		-0.79	-1.21	-1.70	-1.05	-1.44	-1.88
Leisure		0.61	0.31	0.04	0.34	0.18	-1.03

5 Conclusions

The simulation results show that incomes and overall welfare are negatively affected by the policy reform and that impacts are more severe for low income households. The patterns of the households' migration responses appear to make sense. Members of inflexible migration households return from migration whereas members of flexible migration households tend to work more outside the province. In this context, the result that people work less in local off-farm activities is in line with local wages declining relatively more than migrant wages. It is, however, surprising that some households get more involved into farming, although agricultural prices are affected negatively by policy changes. It is shown that the simulation outcomes here are strongly driven by adjustments in the prices for household labor and land which take place in the context of the households' adjustment to the price shock.

Unsurprisingly, the impact of a land market is most visible in the context of the factor allocation to agricultural production. The two household groups which decreased their demand for land most in the situation without a land market, i.e. those with the strongest decline in the shadow price for land, make land available on the village market if given the opportunity. This benefits other households as well as they are able to use more land for farming as well as to expand their levels of agricultural production. Households which tend to migrate more in the situation without a land market do so more easily if such a market is present. At the level of household income and welfare changes, this translates into small differences between simulations with and without a land market. With respect to income, those which can increase the use of land are better-off with a land market, while those which reduce it are worse-off. As a consequence, similar differences appear in the welfare impacts of the reform: inflexible migration households as well as middle income households in the flexible migration group are better-off with a land

market: however, low and high income households in the flexible migration group reduce their land use and therefore suffer higher welfare losses in terms of EV. This occurs because their preferences with respect to labor allocation cause these two household groups to put more emphasis on migration which offers lower monetary returns than agricultural production. Thereby, incomes are reduced further than under a missing land market.

A further question of interest in terms of income and welfare is whether land supports the poorer strata of the village population in coping with trade reform. Regarding the effect on impacts on incomes and welfare, the picture is mixed. Low income households in the inflexible migration group are hurt less by trade reform and can even experience an increase in welfare, albeit by a very small amount. Low income households of the flexible migration group, in contrast, loose more with a land market, both in terms of net income and welfare.

Regarding consequences of a land rental market for outcomes at the village level, several statements can be made. First, as the amounts of migrant labor exported from the village are higher with a land market, its presence apparently facilitates migration at the village level. The possibility to rent out land without restrictions would support migration by households wishing to leave. In consequence, this would lead to higher levels of rural-urban migration. Thus, if the patterns observed in the model would prove to be true for the village as well as for rural China as a whole, land markets could contribute to reducing rural-urban disparities and should be assessed positively. This positive assessment, however, should be considered against the observation that with a land market, households which migrate more would be more negatively affected in terms of income losses. The question remains, however, how strongly this effect should be weighted as the observed outcome is a result of the households' stronger preferences towards migration. Second, in the present model, the existence of a land market has no perceivable impact on the poverty outcomes of trade reform. Results for the poverty measures are the same for both simulations. Regarding inequality, however, the land market slightly dampens the inequality enhancing impact of the reform. This effect, although small, points towards an inequality reducing effect of a land market and warrants more investigation.

More generally, modeling a village land rental market highlights the importance of the character of the land tenure regime for the nature of the outcome of policy reforms. The assumption of a perfect market, however, still constitutes a substantial deviation from the reality in the village and requires further improvement. It would be particularly interesting to take into account interactions between migration and the land market. A possible effect of migration on the land market would be, for example, a higher demand for land due to increased income from remittances.

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Annex A: Model Equations

Household Expenditure

$$QD_{ch} = \frac{PD_{ch} * \sigma_{ch} + \gamma_{ch} * (HEXPCP_h - \sum_{c \in CD} PD_{ch} * \sigma_{ch})}{PD_{ch}} \quad \forall c \in CD \wedge h \in H \quad \text{Eq. (A.1)}$$

$$HEXPCONS_h = hoexpconssh_h * YH_h \quad \forall h \in H \quad \text{Eq. (A.2)}$$

$$QDT_{ch} = QD_{ch} * HS_h \quad \forall c \in CD \wedge h \in H \quad \text{Eq. (A.3)}$$

$$HEXPC_h = HEXPCP_h * HS_h \quad \forall h \in H \quad \text{Eq. (A.4)}$$

Household Income

$$YR_h = \sum_{a \in HAOM} \kappa_h * PA_{ah} * QA_{ah} \quad \forall h \in H \quad \text{Eq. (A.5)}$$

$$\begin{aligned} YH_h = & \sum_{f \in FU} \sum_{a \in HAC} WF_{fh} * FDC_{fah} + \sum_{f \in FU} \sum_{a \in HAOL} PA_{ah} * FDD_{fah} + YR_h \\ & + \sum_{f \in FN} FSH_{fh} * WF_{fh} \\ & + hogiftconst(h) + hogovconst(h) + hoshconst(h) \\ & + hosconst(h) + hobloodconst(h) \\ & + \sum_{c \in CN} PD_{ch} * QDT_{ch} \quad \forall h \in H \end{aligned} \quad \text{Eq. (A.6)}$$

$$YT = \sum_{h \in H} YH_h \quad \text{Eq. (A.7)}$$

Non-farm Activities

$$QA_{ah} = \sum_{f \in FU} FDD_{fah} \quad \forall a \in HAO \wedge h \in H \quad \text{Eq. (A.8)}$$

$$\begin{aligned} \kappa_h * PA_{ah} = & WF_{fh} + \frac{1}{\lambda_h} * \varepsilon_{ah} * \delta_{ah} * FDD_{fah}^{(\delta_{ah}-1)} \\ & - pcscal_h * \sum_{c \in CD} QD_{ch} * PD_{ch} \\ & \forall a \in HAOM, f \in FU, h \in H \end{aligned} \quad \text{Eq. (A.9)}$$

$$PA_{ah} = WF_{fh} + \frac{1}{\lambda_h} * \varepsilon_{ah} * \delta_{ah} * FDD_{fah}^{(\delta_{ah}-1)} \quad \forall a \in HAOL, f \in FU \quad \text{Eq. (A.10)}$$

Agricultural Production

$$QINTA_{ah} = inta_{ah} * QA_{ah} \quad \forall a \in HAC, h \in H \quad \text{Eq. (A.11)}$$

$$QVA_{ah} = ivash_{ah} * QA_{ah} \quad \forall a \in HAC, h \in H \quad \text{Eq. (A.12)}$$

$$QINT_{ach} = ica_{ach} * QINTA_{ah} \quad \forall a \in HAC, c \in CI, h \in H \quad \text{Eq. (A.13)}$$

$$QVA_{ah} = \alpha_{ah} * \prod_{f \in F} FDC_{fah}^{\beta_{fah}} \quad \forall a \in HAC, h \in H \quad \text{Eq. (A.14)}$$

$$FDC_{fah} = \frac{\beta_{fah} * QVA_{ah} * PA_{ah}}{WF_{fh}} \quad \forall a \in HAC, h \in H \quad \text{Eq. (A.15)}$$

$$QQ_{ch} = \sum_{a \in A} ioqqqa_{ach} * QA_{ah} \quad \forall c \in CQ, h \in H \quad \text{Eq. (A.16)}$$

Household Level Balances

$$QQ_{ch} + QP_{ch} = QDT_{ch} + QS_{ch} \quad \forall c \in CM, h \in H \quad \text{Eq. (A.17)}$$

$$FSH_{fh} = \sum_{a \in A} FDC_{fah} + \sum_{a \in A} FDD_{fah} + QDT_{"cleis",h} \quad \forall f \in FU, h \in H \quad \text{Eq. (A.18)}$$

$$\sum_{a \in A} FDC_{fah} = FSH_{fh} + QR("clnd",h) \quad \forall f \in FN, h \in H \quad \text{Eq. (A.19)}$$

$$QRM_c = -\sum_{h \in H} QR("clnd",h) \quad \forall c \in CVNT, h \in H \quad \text{Eq. (A.20)}$$

$$YH_h = HEXPC_h + HEXPCONS_h + hexpgift_h + hexpshock_h + hexpsi_h \quad \forall h \in H \quad \text{Eq. (A.21)}$$

$$HEXPC_h = \sum_{c \in CD} QDT_{ch} * PD_{ch} + WALRAS_h \quad \forall h \in H \quad \text{Eq. (A.22)}$$

$$HS_h = hadults_h - \frac{\sum_{a \in HAOM} FDD(f,a)}{tp} + hdepscal * hdeps_h \quad \forall f \in FU, h \in H \quad \text{Eq. (A.23)}$$

Village Level Balances

$$QVX_c = \sum_{h \in H} QQ_{ch} - \sum_{h \in H} QDT_{ch} \quad \forall c \in CVX, h \in H \quad \text{Eq. (A.24)}$$

$$QVM_c = \sum_{h \in H} QP_{ch} + \sum_{h \in H} \sum_{a \in A} QINT_{cah} \quad \forall c \in CVM, a \in A, h \in H \quad \text{Eq. (A.25)}$$

Prices

$$PA_{ah} = \overline{PA_{ah}} \quad \forall a \in A, h \in H$$

$$PD_{ch} = \overline{PD_{ch}} \quad \forall c \in CP, h \in H \quad \text{Eq. (A.26)}$$

$$PI_{ch} = \overline{PI_{ch}} \quad \forall c \in CI, h \in H$$

$$PVA_{ah} = \frac{PA_{ah} * QA_{ah} - QINTA_{ah} * PIA_{ah}}{QVA_{ah}} \quad \forall a \in HAC, h \in H \quad \text{Eq. (A.27)}$$

$$PIA_{ah} = \sum_{c \in C} PI_{ch} * ica_{cah} \quad \forall c \in CI, a \in HAC, h \in H \quad \text{Eq. (A.28)}$$

$$PD_{ch} = WF_{fh} \quad \forall c \in CN, f \in FU, h \in H \quad \text{Eq. (A.29)}$$

$$WF_{fh} = WFV \quad \forall f \in FN, h \in H \quad \text{Eq. (A.30)}$$

Model Closure

$$FSH_{fh} = \overline{FSH_{fh}} \quad \forall f \in F, h \in H \quad \text{Eq. (A.31)}$$

In case of land, additional factor market closures are added to allow for two different land rental market regimes. Equation (A.31) implies that land is fully employed. The two different land market closures are implemented as follows:

For a missing land market, net land rentals are fixed at the level observed in the survey:

$$QR_{ch} = \overline{QR_{ch}} \quad \forall c \in CVNT, h \in H \quad \text{Eq. (A.32)}$$

Furthermore, the village market price for land is fixed:

$$WFV = \overline{WFV} \quad \text{Eq. (A.33)}$$

Equations (A.32) and (A.33) along with Equation (A.31) ensure that each household internally balances supply and demand via adjustments in the shadow price of land while the possibility to leave land fallow or to draw additional land in production is ruled out. Lacking village markets for other village traded goods or factors Equation (A.32) essentially reduces the village model to

a number of agricultural household models which are solved in parallel. To fully implement this land market closure, Equation (A.30) is dropped from the model.

To allow for a village land rental market, Equation (A.30) is included into the model and the land rentals by migrated households are fixed at their initial level:

$$QRM_c = \overline{QRM_c} \quad \forall c \in CVNT. \quad \text{Eq. (A.34)}$$

With the village market price for land and the households' shadow price as well as net land rentals being flexible, supply and demand for land are reconciled within the village with a land rental rate which clears the village market. Under this regime, due to Equation (A.30) household shadow prices for land are always the same across households.

The notation chosen follows the lines of the GLOBE global CGE model (McDonald et al., 2007) and the IFPRI standard model (Löfgren et al., 2002).

Annex B: Model Sets

Table B.1: Model Sets (as in GAMS Code).

	Set	Description
Activities	A	All activities
	AC(A)	Cobb-Douglas activities
	AO(A)	Off-farm work activities
	AOM(A)	Migration activities
	AOL(A)	Local off-farm activities
	AOF(A)	Formal local off-farm activities
	AOI(A)	Informal local off-farm activities
Commodities	C	All commodities
	CI(C)	Intermediate input commodities
	CQ(C)	Commodities produced by households
	CD(C)	Commodities consumed by households
	CM(C)	Commodities traded by households on the market
	CN(C)	Non-traded commodities consumed by households
	CVNT(C)	Village non-traded commodities
	CVX(C)	Village exported commodities
	CVM(C)	Village imported commodities
Factors	F	Factors
	FU(F)	Utility factors
	FN(F)	Non-utility factors
Households	H	All households
Cross-sets to map activities to households		
	HA(H,A)	All household specific activities
	HAC(H,A)	Household Cobb-Douglas activities
	HAO(H,A)	Household off-farm activities
	HAOL(H,A)	Household local off-farm activities
	HAOF(H,A)	Household formal local off-farm activities to households
	HAOI(H,A)	Household informal local off-farm activities to households
	HAOM(H,A)	Household migration activities
Sets with household specific activities		
	HALMHI(A)	Activities of inflexible migration high income household
	HALMMD(A)	Activities of inflexible migration middle household
	HALMLO(A)	Activities of inflexible migration low household
	HAHMHI(A)	Activities of flexible migration high income household
	HAHMMD(A)	Activities of flexible migration middle income household
	HAHMLO(A)	Activities of flexible migration low income household

Table B.1 describes the sets of the village equilibrium model used in the GAMS code. The notation follows the convention of GAMS, i.e. XY(X) indicates that the set XY is a subset of X.

Annex C: Model Parameters and Variables

Table C.1: Parameters.

Parameter	Description
$actfacsh_{fah}$	Share of activity a in use of factor f in household h
$alpha_{ah}$	Efficiency parameter in CD production function
$beta_{fah}$	Share parameter of CD production function
$delta_{fah}$	Exponent for labor in activity a in labor utility function
$epsilon_{ah}$	Shift parameter in labor utility function
$gamma_{ch}$	Share parameter of Stone-Geary utility function
$hactive_h$	Number of economically active members in household
$hdeps_h$	Number of dependants in household
$hdepscal$	Scaling factor for dependants in household
$hexpgift_h$	Expenditure of household h on gifts
$hexpshock_h$	Expenditure of household h on shocks
$hexpsi_h$	Expenditure of household h on savings
$hobloodconst_h$	Income of household h from blood sales
$hoexpconssh_h$	Share of household h of expenditure on construction
$hogiftconst_h$	Income of household h from gifts
$hogovconst_h$	Government transfers received by household h
$hosiconst_h$	Income of household h from savings
$hoshocconst_h$	Income of household h from shocks
ica_{cah}	Share of intermediate input commodity c in quantity of aggregate input in activity a of household h
$ielast_{ch}$	Income elasticity of household h for commodity c
$inta_{ah}$	Leontief Parameter for demand for aggregate intermediate input by CD activity a of household h
$ioqqqa_{ach}$	Share of commodity c in output by activity a of household h
$ivash_{ah}$	Value-added coefficient of CD activity a of household h
$kappa_h$	Share parameter of remittances function of household h
$lambda_h$	Marginal utility of income of household h
$pcscal_h$	Scaling parameter for household per capita consumption in the labor allocation function for migration
$sigma_{ch}$	Per capita subsistence consumption quantity of commodity c of household h
tp	Time period covered by the model

Table C.2: Variables.

Variable	Description
FDC_{fah}	Use of factor f by CD activity a in household h
FDD_{fah}	Use of factor f by off-farm work activity a in household h
FSH_{fh}	Household endowment with factor f
$HEXPC_h$	Consumption expenditure of household h
$HEXPCONS_h$	Expenditure of household h on construction
$HEXPCP_h$	Per-capita consumption expenditure of household h
HS_h	Number of persons (consumer equivalents) living in the household
PA_{ah}	Price of activity a to household h
PD_{ch}	Consumer price of commodity c to household h
PI_{ch}	Price of intermediate input c to household h
PIA_{ah}	Aggregate price of intermediate input in activity a of household h
PVA_{ah}	Value-added price of activity a to household h
QA_{ah}	Output of activity a in household h
QD_{ch}	Per capita demand of household h for commodity c
QDT_{ch}	Total demand of household h for commodity c
$QINT_{ach}$	Demand of activity a in household h for intermediate commodity c
$QINTA_{ah}$	Aggregate demand of activity a in household h for intermediate commodity c
QP_{ch}	Quantity of commodity purchased by household h
QQ_{ch}	Quantity of commodity c produced by household h
QR_{ch}	Net quantity of village traded commodity c rented by household h
QRM_c	Net quantity of village traded commodity c rented by migrated household
QS_{ch}	Quantity of commodity c sold by household h
QVA_{ah}	Quantity of value-added of CD activity a of household h
QVM_c	Quantity of commodity c imported into the village
QVX_c	Quantity of commodity c exported out of the village
$WALRAS_h$	Slack variables
WF_{fah}	Price for factor f in activity a of household h
WV	Village price for land
YH_h	Total income of household h
YR_h	Remittance income of household h
YT	Total income of all households