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Growing together or growing apart?

A village level study of the impact of the Doha round on rural China

by

Marijke Kuiper & Frank van Tongeren*

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*Agricultural Economics Research Institute (LEI) – Wageningen UR

Abstract

Most studies of the opening of the Chinese economy focus at the national level. The few existing disaggregated analyses are limited to analyzing changes in agricultural production. In this paper we employ an innovative village equilibrium model that accounts for nonseparability of household production and consumption decisions. This allows us to analyze the impact of trade liberalization on household production, consumption, and off-farm employment, as well as the interactions among these three aspects of household decisions. The village model is used to analyze the impact of price changes and labor demand, the two major pathways through which international trade affects households. Analyzing the impact of trade liberalization for one village in the Jiangxi province of China we find changes in relative prices and outside village employment to have opposite impacts on household decisions. At the household level the impact of price changes dominates the employment impacts. Comparing full trade liberalization and the more limited Doha scenario, reactions are more modest in the latter case for most households, but the response is non-linear to increasing depth of trade reforms. This is explained by household-specific transaction (shadow) prices in combination with endogenous choices to participate in the output markets.

Rising income inequalities are a growing concern in China. Whether trade liberalization allows incomes to grow together or to grow apart depends on whether one accounts for the reduction in aggregate consumption demand when household members migrate. Assessing the net effect on the within-village income distribution, we find that poorer households that own draught power gain most from trade liberalization. The households that have to rely on the utilization of own labor for farm activities and are not endowed with traction power, nor with a link to employment opportunities in the prospering coastal regions, have fewer opportunities for adjustment.

Introduction

Gradual integration into the global economy, combined with far-reaching domestic reforms, has made China a showcase of attaining rapid economic growth through market-based reforms. The rapid economic growth during the past decades, however, has been accompanied by an increasing disparity between coastal and interior regions and between rural and urban areas. The coastal cities benefited most from the increasing export opportunities, due to a combination of geographical factors and deliberate policies (Démurger *et al.*, 2002).

The extent of reforms in combination with the sheer size of the Chinese economy has resulted in a body of literature with a growth rate rivaling China's GDP growth. Most studies of the opening of the Chinese economy to the rest of the world focus on the national level impacts. One exception is a study by Diao *et al.* (2003) on the regional impact of China's recent WTO accession. As in other national level studies, they find a positive aggregate effect for China as a whole. This aggregate effect obscures differences across regions. Reflecting past trends of diverging growth between coastal and inland provinces (see for example Démurger *et al.*, 2002; Jones *et al.*, 2003), income gaps between provinces are found to widen following WTO accession. They also find rural-urban migration provides an important mechanism for transmitting urban growth to the rural areas. Especially central provinces bordering the booming coastal provinces (Anhui, Jiangxi, Hubei and Hunan) benefit from an increase in rural-urban migration.

A second exception to the common use of a national level analysis is a study by Huang *et al.* (2003) analyzing the impact of WTO accession on farm households. They find that despite a small positive aggregate impact of the WTO, the distribution of benefits gives cause for concern. Households in richer coastal areas benefit most, having higher yielding lands and cultivating internationally competitive crops. Another interesting finding of their

household level analysis is an increase in aggregate agricultural production, despite a decrease in the agricultural price index. Farmers respond to the changes in relative prices induced by the WTO by shifting to more competitive activities (livestock, fish, vegetables and rice), resulting in a net increase in agricultural production.

These two studies show that a disaggregated analysis of the impact of trade reform yields insights that diverge from insights gained at the national level. Our objective in this paper is to contribute a village-level perspective on trade reform in China. Adjustment responses of different household types and within-village interactions are central to this analysis. This study complements earlier studies by zooming in on the differential impact of trade liberalization on households within a village. A new methodology that accounts for family-farm production specifics in a village-economy setting gives us a unique perspective on the impact of trade reform. Going beyond the household level study of Huang *et al*. (2003) we account in addition for the impact of farm income on rural household consumption. We furthermore account for the impact of rural-urban migration, thus not limiting the analysis to developments in the agricultural sector.

In this study we combine a macro level analysis of trade reform, with a village level general equilibrium model of a rice-producing village in Jiangxi Province. To be able to combine the macro and village level analysis of trade reform, we need to ascertain how trade reform affects households. Prices and labor demand form the key transmission mechanisms through which macro level trade reform affects rural households (Winters, 2002). We therefore focus on changes in prices for consumed goods, agricultural inputs and outputs, and on the increased demand for labor by labor-intensive sectors in which China has a comparative advantage.

Our analysis of further trade reform builds on a baseline that encompasses China's recent WTO accession, phasing out the export quota for textiles under the Agreement on

Textiles and Clothing. We draw on global results for an assessment of the macro-level impacts of further reform under a WTO–Doha round and feed these into the village-level model. Specifically, we simulate the impacts of the standard *Doha* scenario, as well as the *Full-Lib* scenario. In both cases we disentangle the effects of changing prices for inputs and outputs from the effects of increases in off-farm employment and wages.

The full liberalization scenario provides a useful benchmark against which the less ambitious Doha scenario can be compared. Analyzing consumption we find that poorer households face a stronger rise in expenditures. This is due to a larger share of agricultural goods in their consumption and a shift from being net-sellers to self-sufficiency in the case of some households.

Analyzing the impact of changing agricultural input and output prices (with unchanging employment and wages), we find an increased village supply of rice and other livestock, which corresponds with the findings of national level studies and with the results of the farm household analysis in Huang *et al.* (2003). This increased supply of rice, however, is the net result of three household groups increasing rice production, and one group reducing rice production.

The net impact of more off-farm employment (at constant prices) following global trade reform is a decrease in rice supply, caused by an increasing scarcity of labor. Again we find divergent household responses, with some households increasing rice production due to lower costs of animal traction rented within the village. Since this is opposite in sign to the impact of higher prices, it is interesting to ask which dominates. We find that the impact of price changes dominates the impact of increased employment.

A more modest liberalization within the context of the Doha round has a similar, but less pronounced, impact as observed under full trade liberalization. The notable exception is

the village rice economy. Under our full liberalization scenario rice production becomes more intensive in land and labor, and village marketed surplus increases.

1. A Household Perspective on General Equilibrium Modeling

A disaggregated perspective can lead to new insights in the impact of trade reform. Separating farm production decisions from household consumption decisions is standard practice in general equilibrium models, both macro as well as existing village general equilibrium models. Ignoring the interdependency of household production and consumption decisions, however, can be misleading when market imperfections render these two aspects of household decisions nonseparable.

Nonseparability of household production and consumption decisions occurs when the effective price of a commodity used both in production and consumption is not exogenous to the household, but is determined endogenously by household demand and supply. In this case, production decisions will affect supply of the commodity, which affects its shadow price and hence consumption decisions, and vice versa. Such nonseparability occurs if households are not price-takers in a market, if markets are missing, or if there is a gap between buying and selling prices (Löfgren and Robinson, 1999). The seminal work of De Janvry, Fafchamps and Sadoulet (1991) shows how rational behavior of farmers in combination with market failures may give rise to sluggish or counterintuitive household responses.

There are a number of points that are essential to farm household modeling. First, standard economic rules for production and consumption remain valid. Differences with a separate analysis of production and consumption decisions occur because of endogenous prices, not because of different behavior by the household. Consequently standard approaches to modeling production and consumption decisions can be followed. But endogenous

household prices complicate empirical work. The endogenous household shadow prices are an analytical construct and thus cannot be directly observed. This complicates the estimation of demand and supply functions for nonseparable household models.

Second, household models tend to generate ambiguous results and quickly become analytically intractable. Ambiguous results may already occur with perfect markets. Assume that prices for food increase. This will increase food production and thus household income. The higher income prompts an increase in consumption, which may outweigh the increase in food production, depending on the preferences of the household. The food price increase then does not lead to an unequivocal increase in marketed surplus. In fact, if the income effect is strong enough, sales by the household will actually fall. Thus, in those cases where an analytical solution of the household model can be obtained, it will generally be difficult to sign the effects because of counteracting effects on the production and consumption sides of the household. Models with multiple missing markets complicate things even more.

A third point about household modeling is the importance of accounting for different levels of market integration of households from a policy perspective, as can be illustrated with a price band model (Figure 1). Starting from an exogenous market price, transaction costs increase the effective purchase price, and decrease the effective sales price faced by the household. Household demand and supply then determine the household-specific shadow price of the commodity, with effective purchase and sales prices forming upper and lower boundaries. Figure 1 shows the supply curve for three different types of households. Depending on the intersection of the demand and supply curve, a household is (*1*) a net buyer, (*2*) self-sufficient, (*3*) a net seller of the commodity. If the household is a net buyer or seller, the household shadow price equals the effective purchase or sales price. If the household is self-sufficient (case *2*), the household shadow price is endogenously determined within the price band and decisions become nonseparable. A missing market can be

conceptualized in this model as a wide price band (in the most extreme case, a sales price of zero and an infinite purchase price), such that all households always operate within it.

Household response then consists of two decisions, (*i*) a discrete decision on market-position, determining their position as net buyer, net seller or not participating; (*ii*) a continuous decision on production and consumption levels, determining supply response. The position of the household in the market determines the effective decision-making prices for the second decision. Net buyers will respond differently to a price increase than net sellers, while households operating within their price band will not show any response to the price change. The position of the household in the market, thus has an important impact on the household response to price incentives.

Nonseparability has become an important feature of household models, but is absent in applied general equilibrium models. A study by Löfgren and Robinson (1999) provides a stylized application of including farm-household models in a general equilibrium model, but this approach has not previously been implemented in an empirical analysis.

Given the recent transformations in China, markets are still developing and imperfections can be expected to be abound. Studies of factors influencing migration decisions (Hare, 1999; Murphy, 2000; Rozelle *et al.*, 1999a; Rozelle *et al.*, 1999b) and of patterns in inequality (Benjamin and Brandt, 1999), refer to imperfect land, labor and credit markets as being relevant in the Chinese context. Such a partial integration in markets may give rise to nonseparability of household decisions, or may create (thin) local markets through which household decisions affect each other.

If households interact with each other in local village markets, and these markets are not integrated with markets outside of the village, local general equilibrium effects occur. Studies of market integration in China find villages to be integrated in markets for major outputs (Huang *et al.*, 2003) and for fertilizer (Qiao *et al.*, 2003). While villages may thus be

assumed to be integrated in agricultural input and output markets, integration of factor markets is still limited. Labor markets are highly segmented (Gilbert and Wahl, 2003), resulting in a rural labor surplus (Cook, 1999), which is only partly absorbed in Township-Village Enterprises The local village labor markets are limited in rural areas, including the labor market in our case study village in Jiangxi province. A prime reason for limited development of a rural labor market is the collective ownership of land, which grants all households access to land. Consequently, there are no landless households that would specialize in wage earning activities, and hence little scope for local labor markets.

In spite of land tenure reforms that have granted household user rights for 30 years, and recently were changed to permit inheritance, land rights remain ambiguous (Huang and Rozelle, 2004). Land is allocated on the basis of demographic criteria, and readjustments occur to adjust for changes in household size, despite formal household user rights. The result is an ambiguous land tenure situation (Ho, 2001) in which households have an incentive to keep their land cultivated to avoid losing it during the next readjustment. Households that migrate to urban areas rent their land to other local households, seeking to maintain their claim to the land in case they are unable to secure a living in the urban areas. Given the ambiguity of land tenure, land rental markets are inherently local in nature.

Village interactions may also arise through informal credit markets. Government intervention in the formal banking sector remains strong. Regulated interest rates are well-below market clearing levels, while soft loans to state enterprises seize a large share of available funds. Rural households are thus rationed out of credit markets. In the late 1980s, rural cooperative funds developed, targeted at rural households. These funds proved to be too successful competitors for existing rural credit cooperatives and were dissolved in 1999 (Park *et al.*, 2003). As a result of the lack of formal credit options, household have to rely on local informal credit markets. In this study we therefore use a village level general equilibrium

model to account for the interactions among households in the local markets for land and capital, while paying due attention to nonseparability of household decisions flowing from the presence of significant transactions costs.

Taylor and Adelman (1996) pioneered the use of general equilibrium models at the village level. Their model closely follows the structure of macro level models, for example by modeling production at the sector level, which misses the impact of nonseparability of household decisions. We take a different approach to village modeling, placing differences in household response due to nonseparability at the center of the model. This household perspective on general equilibrium modeling results in a different model structure than used in macro level general equilibrium models and in existing village level models. We model production activities as being household-specific. This allows for idiosyncratic household responses consistent with nonseparability of production and consumption decisions. A second major difference is the nesting structure used for modeling production decisions. For each activity the production structure is calibrated based on the household survey data[1]. As a result we have household specific production functions, capturing differences in household access to inputs[2].

By placing households at the center of the model, the village model used in this study is able to capture differences in production decisions reflecting differences in access to inputs, interactions between household production and consumption decisions, and interactions among different households within a village economy.

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[1] Our estimation also rejected the commonly assumed separability of factors and intermediate inputs, and this assumption was therefore dropped in the village equilibrium model.

[2] Detailed description of the village equilibrium model and calibration procedures can be obtained from the authors.

2. Models and Data

2.1 Linking macro results to the village model

We analyze the village-level impact of two liberalization scenarios: full trade liberalization, as well as a Doha round scenario. Since we do not model the Chinese economy at the national level, the GTAP results *include* China's tariff cuts as well as liberalization in the rest of the world.

To link the macro-shocks for China to the village model, we follow the conceptual framework of Winters (2002), and focus on prices and labor demand. Studies of market integration of three main staple crops and fertilizer (Huang *et al.*, 2003; Qiao *et al.*, 2003) show integrated regional and national markets, with village level prices responding to changes at the national level. These integrated commodity markets allow us to directly translate relative price changes derived from the macro level analysis to the village level.

In addition to the transmission of price changes, we analyze the impact of changes in employment opportunities. Studies of trade liberalization find an expansion of labor-intensive sectors in which China has a comparative advantage. We thus need to link aggregate expansion of employment to village level changes in temporary migration to urban areas. Lacking data to quantify the link between national level changes in employment and household decisions, we assume percentage changes in aggregate labor demand to be completely transmitted to the village. Percentage changes in outside village employment are thus set equal to changes in aggregate labor demand. Such a one-on-one relation between national level employment and off-farm activities of the households in the case study village seems justified given the findings in Diao *et al.* (2003). Comparing the change in rural-urban migration across regions following WTO accession, they find the fastest increase in rural-urban migration in the central provinces. The case study village is located in Jiangxi, one of

these central provinces, and migration outside of the province plays an important role in the village economy, justifying the assumption of a complete transmission of the demand for labor to the village level (the case study village is more thoroughly described below).

Similarly, changes in outside-village wages and changes non-agricultural wages are taken from the GTAP simulations. As will be seen below, the rural-urban wage differential is endogenously determined through modeling of household-specific shadow wages. Mapping macro-level changes computed with the GTAP model to the village level results in the shocks summarized in Table 1.

2.2 The case study village

The case-study village has been selected to be representative of rice producing villages in the plains area of Jiangxi Province, one of the poorer provinces in China. Data on production and consumption of 168 households were collected for 2000, using standard household questionnaires with questions on source and destination of commodities added to allow construction of a village SAM. These surveyed households account for about a quarter of the village population, totaling 729 households.

Differences among households are at the center of our village equilibrium model. Four groups of households are distinguished, using ownership of draught power (cattle or tractor) and access to extra-province employment as grouping criteria. The resulting groups represent households with differential capacity for earning a living from agriculture and from (transitory) migration to coastal cities.

The upper part of Table 2 presents the activities of each household type in terms of contribution to value-added. Taking the first column for the unlinked households with no draught power, we observe that crops are the dominant source of farm value added. One-season rice contributes 9.4 percent to value added, while the more intensive two-season rice contributes as much as 28.5 percent. Other crops, such as vegetables, contribute another 21.2

percent to household value added. The share of livestock is rather limited, with pigs and other livestock each contributing 0.1 percent. For this household group the total contribution of agricultural activities to value added is 59.2 percent, while the remainder is coming from engaging in off-farm activities. Hiring out its labor to other villagers contributes 1.3 percent to value added, while working in local businesses earns 19.4 percent of value added. Outside village employment is a significant income source for this household group, with a share of 18.1 percent. For this unlinked household, migration opportunities are restricted to moving inside the province, which contributes 1.8 percent of value added.

For all household types off-farm employment contributes a significant share of income, but there exist important differences in the nature of non-agricultural income sources. Comparing the two household groups that have no link outside the province, we find that households lacking draught power are oriented more towards local off-farm employment. The households with draught power obtain 71.4 percent of value-added from agriculture, which is similar to the importance of agriculture for the other household group owning draught power. The household group with access to migration but lacking draught power derives about 40 percent of value-added from outside province migration, and only derives about 45 percent of value-added from agricultural activities. Differential access to agricultural and migration opportunities is thus reflected in the composition of household value-added.

Differences in activities result in differences in income patterns across the four household groups. The bottom part of Table 2 presents income per adult consumer equivalent[3] to allow a direct comparison across households. As a crude poverty assessment

[3] Adult equivalent instead of per capita consumption is used to account for differences in consumption between males and females and between age groups. Lacking survey data, conversion factors were taken from detailed consumption data of a study in Bangladesh (Zeller *et al.*, 2001). In addition to differences in age and gender, consumer equivalents were corrected for the length of absence of household members due to temporary migration.

for each household group available income is computed in terms of dollars per day. Three of the household groups fall in between the one and two dollar per day poverty lines. The notable exception is the household group with an outside link and lacking draught power with just over two dollars per day. This is in line with the rural-urban income differences since this household group specializes in outside province migration.

To get a clear view of differences in household endowments that affect household response, the middle part of Table 2 details income sources. Specific features of the village SAM and equilibrium model arise in this table. For example, income from labor and irrigated land is split between shadow income[4] and above shadow income. The household survey data reveal imperfect labor and land markets. Households are involved in a variety of off-farm activities with different wages. These wages are well above the estimated shadow wage, indicating restricted access to off-farm employment and suggesting a situation of labor surplus at the local level. This is not unexpected, given the high population density in rural China and similar findings in a study by Bowlus (2003).

In the SAM and village equilibrium model the demand-constrained labor market is accounted for by valuing labor against household-specific shadow wages, estimated using the household survey data. In case of off-farm activities, labor then earns revenue above the shadow wage which is tracked in a separate account of the SAM. For example, for the unlinked households with no draught power labor is the most important endowment, contributing 74.9 percent to its income, broken down into 57.4 percent coming from shadow wages and 17.5 percent from above shadow wages.

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[4] Nonseparability results in household-specific shadow prices that balance households' unobservable demand and supply. We therefore estimated an agricultural production function, explaining the total value of household output in terms labor-, land-, manure-, feed- and external inputs. The shadow prices are derived from this estimated production function as the marginal value product of each input. Specifically, for each household in the sample the household-specific shadow prices for household non-tradables are derived as the marginal value product of each input. Averaging over the households within a household group yields a

Although there is a rental market of sorts for irrigated land (paddy fields), the village model does not include a land market. When analyzing the village trade in land we found all four households groups to be net renters of land. This is due to a bias in the surveyed sample of households, which excludes households that have migrated from the village. These households are renting out land for a price below the productive value of the land. This difference can be interpreted as an insurance premium the households are willing to pay in order to maintain access to their land, which is collectively owned, in case they need to return to the village. The households remaining in the village thus get an indirect transfer of money from the migration of entire households, through having to pay less than the productive value for land rented in. Analysis of the migration of entire households is beyond the scope of our model. We therefore fix the supply of land at the level observed in the SAM, effectively removing the land market from the model. Taking again the example of the unlinked households with no draught power, the return earned on irrigated land endowment contributes 17.2 percent to its income, broken down into a shadow rent component of 12.4 percent and the above shadow rent component of 4.8 percent. This above shadow rental income results from renting-in land at a price below its marginal production value from migrant households. Non-irrigated land contributes another 7.3 percent to the household income.

A last remark on the village SAM pertains to the lack of data for modeling capital flows in the village. The SAM shows that the household group most involved in migration is a net supplier of capital to the other three groups of households. Although the survey contains some data on the conditions such funds are loaned, insufficient information is available to model a village-level capital market. We therefore assume that the household group lacking draught power but having an outside link spends a fixed share of its income on within-village

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shadow price for each household nontradable and each household group. These shadow prices are used in constructing the SAM and in calibrating the village equilibrium model.

transfers. These transfers are allocated to the three household groups based on their share of transfers in the SAM. The model thus includes a rather simple mechanism through which the income from migration is transmitted through village linkages.

To summarize the discussion so far, we are analyzing the response of four different types of households, distinguished on the basis of their access to agricultural income and income from outside province migration. Analyzing sources of income pointed to imperfect labor and land markets. These are accommodated by estimating household-specific shadow prices, introducing profits earned on off-farm employment and renting of land, and by modeling household production and consumption decisions as nonseparable.

2.3 The village equilibrium model

Despite introducing nonseparability of household production and consumption decisions, the mathematical structure of the model closely resembles macro level general equilibrium models. Consumption decisions are modeled through a linear expenditure system, while production is modeled by nested CES functions. Table 3 summarizes the key substitution elasticities for each activity. The estimation procedure for obtaining these substitution elasticities exploits the inter-household variation in the survey data. The nesting structure differs across activities and is determined by statistical testing based on pairwise comparisons. Kuiper (2005) provides full details of this method.

The village model does not attempt to treat two-way flows of commodity trade with the outside world. Households consume farm output, but do not purchase these goods from outside the village, nor from other households in the village. Household sales to outside village markets are thus equal to total production minus household consumption.

Village markets exist for traction by draught animals or tractors, and for locally produced consumption goods. Of these village markets, only animal traction has an endogenous village price in the model. The SAM indicates that only limited use is made of

the tractors. This under-utilization of available tractors is therefore modeled through fixed prices for tractor services, the volume of which adjusts endogenously to demand.

Off-farm employment options were found to be restricted, resulting in wages exceeding the shadow price of labor. This is handled in the village equilibrium model by fixing the levels of outside village employment and having households earn a profit above labor costs on off-farm activities. Levels of village employment (agricultural and nonagricultural) cannot be fixed, although for these activities wages also exceed shadow wages. Agricultural employment is therefore assumed to be demand-driven, with prices being exogenously fixed[5]. Demand for non-agricultural labor in the village economy is linked to local business activities, to which we now turn.

Due to lack of data on other inputs, local business activities use only labor (village non-agricultural labor), yielding a return that exceeds the shadow wage. All households are involved in local business activities and all of them purchase locally produced goods. This reflects a heterogeneity in goods not captured by the aggregates used in the SAM and village model. Because of a lack of data, we fix village prices of local goods to deal with the gap between product prices and costs of labor. Assuming fixed prices seems justified, since prices of village produced goods are common knowledge, while shadow wages cannot be observed. Given the unobservable character of shadow wages, it seems unlikely that a change in labor costs will be reflected by a change in the village price. A second reason for fixing prices of local business activities is the absence of a peak season. Production can therefore be shifted to times when little labor is needed in agriculture, limiting the need to increase the price when shadow wages increase.

[5] Agricultural wages are in excess of shadow wages. Households are therefore always willing to supply additional agricultural labor when it is demanded.

For all demand-driven activities (local consumption goods, hired agricultural labor, tractor services), market equilibrium is established by allocating demand to suppliers based on the initial market shares recorded in the SAM.

Finally, all surveyed households are net sellers of agricultural production, *i.e.* they begin in regime 3 of Figure 1. The simulations may result in a regime change for households, possibly turning some household groups into net buyers. Lacking observations from the survey we use an estimate of transaction costs for rice from Park et al. (2002) to set the width of the price-band at 25 percent of the selling price. Thus households will become net buyers if their shadow price rises 25 percent above the initial selling price.

Summarizing, the village equilibrium model resembles commonly used macro level general equilibrium models in the way in which consumption and production are modeled. A major difference with macro and existing village level models is household-specific production, which is affected by household consumption decisions through endogenous household shadow prices. Lack of data resulted in most village markets to be modeled as fixed price, demand-driven equilibria. The only exception is the village market for animal traction, which is balanced through an endogenous village price. Household production and consumption decisions are calibrated on the household survey data, resulting in household-specific demand and supply functions.

3. Full Liberalization Impacts

There are two major pathways through which trade liberalization affects households: changes in prices of consumed goods, agricultural inputs and outputs and changes in off-farm employment and wages. In this section we first analyze each of these two pathways separately before looking at the combined impact of the full liberalization scenario.

3.1 The impact of price changes with full liberalization

We focus the discussion of price changes on the changes in production. Prices of consumption goods increase as the demand for China's products overseas increases strongly and she experiences a real appreciation. The price increases in agricultural output, however, outstrip the increased cost of consumption. More importantly, whereas households have limited opportunities to change their consumption patterns, they have much more flexibility in changing their mix of production.

With full liberalization all household groups increase other livestock production, while three out of four intensify rice production and shift towards two-season rice (Table 4). There are two forces that account for these shifts in production. First of all, due to the absence of a credit market, livestock production is cash-constrained. The rise in output prices increases the availability of cash for all households, resulting in an expansion of previously constrained livestock production. The switch to other livestock instead of pigs is due to differences in input use. Pig production uses purchased feed, which experiences a strong price increase of 4.1 percent, while external inputs used in other livestock increase with only 0.4 percent which is well below the rise in output prices.

The second driving force behind the shift in production patterns is the increase in rice prices, making more intensive rice production attractive. Rice production can be intensified by switching from one-season to two-season rice, thus doubling the use of the available irrigated land. Having two cropping seasons strongly increases the demand for labor, which explains the opposite production response of the household group with draught power, but lacking an outside link. This household starts to rent out draught power and invests the proceeds in intensive (other) livestock production, and it reallocates labor from two-season rice production towards intensive livestock. It ceases to be a seller of two-season rice and of pigs, moving into regime 2 in Figure 1. It almost becomes a buyer of pigs, with its household-

specific price for pigs rising by 21 percent, but this price rise falls just within the 25 percent price band, and hence it does not yet become a buyer. Similarly, the fourth household in Table 4 ceases to sell one-season rice.

Summarizing, changes in agricultural input and output prices increase the availability of cash allowing an expansion of previously constrained livestock production. It furthermore leads to an intensification of rice production for those household groups that have sufficient labor resources.

3.2 The household as a supplier of labor: the impact of increasing off-farm employment

Off-farm employment is an important source of income. For the village as a whole 41 percent of income is generated from off-farm sources, both inside the village in local business activities, as outside the village and even from employment outside the province. For the household lacking draught power but having an outside link, for example, migration accounts for close to 40 percent of value-added. An increase in off-farm employment opportunities is simulated in scenario Full Liberalization B, through rising wages and increased employment demand. To clarify the impact of this second pathway through which trade liberalization affects households, we now abstract from the price changes of inputs and outputs associated with full liberalization.

Per capita consumption is of course increased by the additional income. This holds especially for the households involved in migration, since the number of household members present in the village decreases. This leaves more income for the remaining household members.

Increased off-farm employment decreases the available agricultural labor force, which leads to less labor-intensive agricultural production for three of the household groups,

resulting in a slight decrease of two-season rice and a marked increase of other livestock production (Table 5). The driving force behind this response is the village market for animal draught services. With 'linked' households moving to one-season rice, demand for animal traction is reduced and its price falls. This means that the renting-in of draught power becomes cheaper for the household group with no animal traction and no outside employment.

The third household receives about 40 percent of its income from migrant labor. It responds to the employment opportunities generated by full liberalization by shifting resources out of agriculture, and concentrating more on off-farm employment. It does, however, keep some rice production and pigs. Pig production uses less labor than other livestock, and is thus a more attractive option with increasing shadow wages resulting from a rise in off-farm employment.

The driving forces behind the diverging response of the fourth household group, those owning draught power and having a link outside the province, are endowments of labor and access to migration. The access to migration outside the province provides an important source of cash, just as it does for the other household group with an outside link. The fourth household, however, has the largest labor endowment of all households, and this tempers the rise in its shadow wages. As a result, the labor and cash-intensive other livestock production is more attractive than pig production for this one household group.

Interestingly the second household, with no outside link but with ownership of draught power, chooses to stop selling other livestock. Its shadow price of other livestock rises just above the market price and it becomes more attractive to use the output for own consumption.

Summarizing the results in this section, we find that an increase in off-farm employment reduces the agricultural labor force. While the wage hike encourages a switch

towards less-labor intensive pig production on the part of some households, the village as a whole shows little change in pig production, but a large increase in other livestock production.

3.3 Combining price and employment effects

The above discussion shows that price effects of liberalization may move opposite to the effects of improved off-farm employment opportunities, depending on the initial household endowments and on their links with the economy outside the village. The combined effect is summarized in Table 6.

At the village level, price and employment changes have an opposite impact on rice and pigs exported from the village. Where rising output prices promote rice and other livestock production, increasing off-farm employment opportunities tends to reduce the marketed surplus of labor intensive agricultural output. When these two elements of the *Full-Lib* scenario are combined, the price effects dominate and the result is a more labor intensive package of outputs. The net effect is a marked 37 percent rise of village marketed surplus, mainly driven by expansion of other livestock. To put this huge increase in perspective, we have to be aware that the contribution of this commodity to the village's marketed surplus is just two percent in the base, whereas it becomes 29 percent in the wake of full liberalization. The other important surplus commodity is two-season rice, which contributes 62 percent of the village marketed surplus in the base, and still accounts for 50 percent in the *Full-Lib* scenario.

4. Doha Impacts

Having established the maximum potential impacts of trade reform on this village economy, we now turn to the Doha scenario. The second set of bars in Figure 2 summarizes

production responses at the village level. For pig production and other livestock the Doha scenarios produce a less pronounced response than the full liberalization scenario. This is to be expected, since the exogenous price shocks are smaller under Doha. But in both cases pig production decreases and other livestock increases remarkably (note that we express changes in other livestock in per 1000 instead of per cent for expositional clarity).

For rice production a more interesting aggregate response emerges. Under our full liberalization scenario rice production becomes more labor and land-intensive, with an increase in two-season rice and a decrease in one-season rice. This is due to the combined effect of households three and four moving into more intensive rice production in response to rising prices (Table 6), while household two specializes in renting out traction power and consequently has to switch to less intensive own rice production.

Under the Doha scenario, however, we see a de-intensification of rice production in the village and a drop in aggregate rice output. Rice prices do not increase enough and shadow wages do not rise enough to induce the 'linked' households to specialize in more labor intensive forms of farming. For these 'linked' households, economic developments outside the village are paramount. Those 'linked' households without draught power are most engaged in outside province migration and are able to realize substantial gains already from the more modest Doha scenarios by seizing the improved employment opportunities.

5. Impacts on Inequality

Growing income inequalities are now at the top of the policy agenda in China. The rural-urban income inequalities are transmitted to the village by asymmetric access to migration. The household group with the strongest involvement in migration also has the highest income per adult equivalent (see Table 2). The increase in employment following trade liberalization may therefore be expected to increase within-village income inequality.

The impact of an increase in agricultural output prices, on the other hand, may be expected to benefit the households owning draught power but lacking an outside link, since the activities of this household group are concentrated in agriculture.

Table 7 summarizes income effects in terms of equivalent variation per adult equivalent. The simulated income gains are substantial, with an average increase of income over base levels as high as 21 percent under the full liberalization experiment. Under the Doha scenario, the income gains are reduced to about five percent, due to the smaller price changes.

In both cases, above average gains from price effects are observed for the household without an outside link and owning draught power. Under full liberalization this household group gains 725 yuan per adult equivalent, or 33 percent of its base level income per adult equivalent. Ownership of capital in the form of draught power is decisive for the relative size of the gains.

Most gains from increased employment opportunities fall on the households engaged in outside employment and not owning draught power. Under full liberalization this amounts to 123 yuan, or four percent of its base household income under full liberalization. Employment contributes 38 percent of the total gains under this scenario, while price changes contribute 62 percent (Table 8). Under the more modest Doha scenarios, with limited price changes, the employment component contributes as much as 70 percent of the gains for this household group. In general terms, outside village employment effects following trade liberalization indeed increase income inequality within the village, but the welfare gains from employment are substantially smaller than the gains from prices changes. Combining both effects, we note that the rising income inequality may be compensated by gains from specialization for those who stay behind. The net effect on the within-village income distribution is determined by the interplay of initial endowments, village markets for inputs

and outputs and by market imperfections. As a result, it appears that even poorer households begin to catch up. The households that have to rely on the utilization of own labor on the household farm and are not endowed with traction power nor with a link to employment opportunities in the prospering coastal regions have fewer opportunities for adjustment. In fact the only option for them is to farm rice more intensively and to shift into the labor intensive other livestock production.

6. Conclusions

In this study, we employed an innovative village equilibrium model, which fully accounts for nonseparability of household production and consumption response. This allowed us to analyze the impact of trade liberalization on agricultural supply response and off-farm employment, while simultaneously accounting for household consumption decisions. The village model is used to analyze the impact of trade liberalization, which was quantified through macro level shocks to the Chinese economy obtained from GTAP model simulations. We analyzed the impact of price changes and labor demand, the two major pathways through which international trade affects households.

Our full liberalization benchmark shows results that are well in line with the findings of national level studies and with the results of the household analysis in Huang *et al.* (2003). Analyzing the impact of changes in agricultural input and output prices, we find an increased village supply of rice and other livestock. As the cash constraint is lifted in the wake of rising incomes following liberalization, the households invest the proceeds in the capital intensive activity of livestock production. The increased supply of rice is the result of more complex interactions, however, as some household groups increase rice production, while others reduce rice production.

Apart from influencing agricultural input and output prices, trade liberalization increases off-farm employment opportunities. The net impact of more off-farm employment is a decrease in rice supply, caused by an increasing scarcity of labor. Again we find diverging household response, with some households increasing rice production due to lower costs of animal traction rented within the village.

Employment and migration leads to less intensive rice production and a drop in village marketed surplus. Combined with the price effects from full liberalization, we observe increases in rice surplus. This is quite interesting, as one household specializes in renting out traction services to the households engaged in migrant employment, and decreases its own rice production. In terms of the village supply response, the impact of the change in prices thus dominate the impact of increased employment.

The two pathways through which trade affects households thus have an opposite impact on household production response. Assessing the combined effect at the household level, the dominant aspect of trade liberalization depends on household endowments and production activities. We observe changes in intra-village specialization, depending on the households' endowments and the strength of their linkages with the outside economy. We furthermore found that a strong involvement in off-farm employment does not necessarily imply that the employment aspect of trade liberalization dominates household response, thereby hampering *ex ante* judgments about the most relevant aspect of trade liberalization for a specific household type.

A more modest liberalization within the context of the Doha round has a different impact on the village rice economy from full trade liberalization. The reason for this non-linear response to increasing depth of trade reforms lies in the household-specific transaction (shadow) prices in combination with endogenous choices to participate in the output markets. Taking transaction costs into account, some households choose to withdraw from the market

if their own shadow price is greater than the market price. Clearly, a partial reform scenario, such as Doha, leads to less pronounced output price changes than full liberalization.

Under the Doha scenario, average income gains amount to about five percent, while under full liberalization the gains are four times as high. However, the impacts vary by household type and the question arises whether such changes will reduce or exacerbate existing inequalities in China. Whether trade liberalization allows incomes to grow together or to grow apart depends on whether one accounts for the reduction in consumption demand when household members migrate. Assessing the net effect on the within-village income distribution, we find that even poorer households are able to catch up. The households that have to rely on the utilization of own labor on the household farm and are not endowed with traction power nor with a link to employment opportunities in the prospering coastal regions have less opportunities for gains. Thus although rural-urban migration can transfer benefits from economic growth in the coastal provinces to inland provinces, asymmetric access to migration implies that the rising rural-urban income differences are transferred as well.

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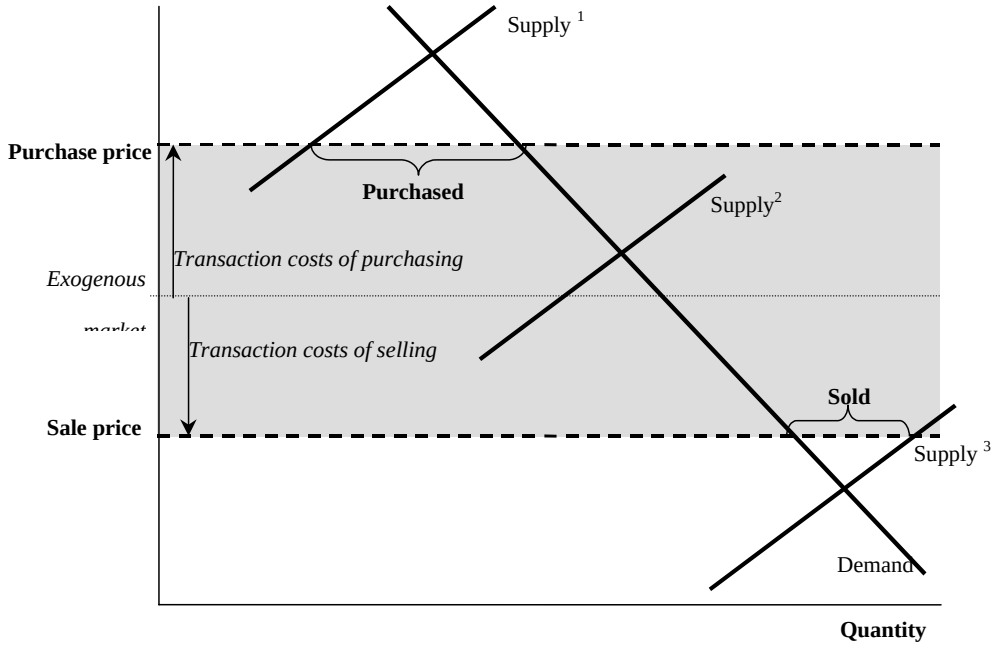
Figure 1: Household supply response with price bands



Source: adapted from Sadoulet and de Janvry (1995)

Figure 2: Village production response under alternative liberalization scenarios

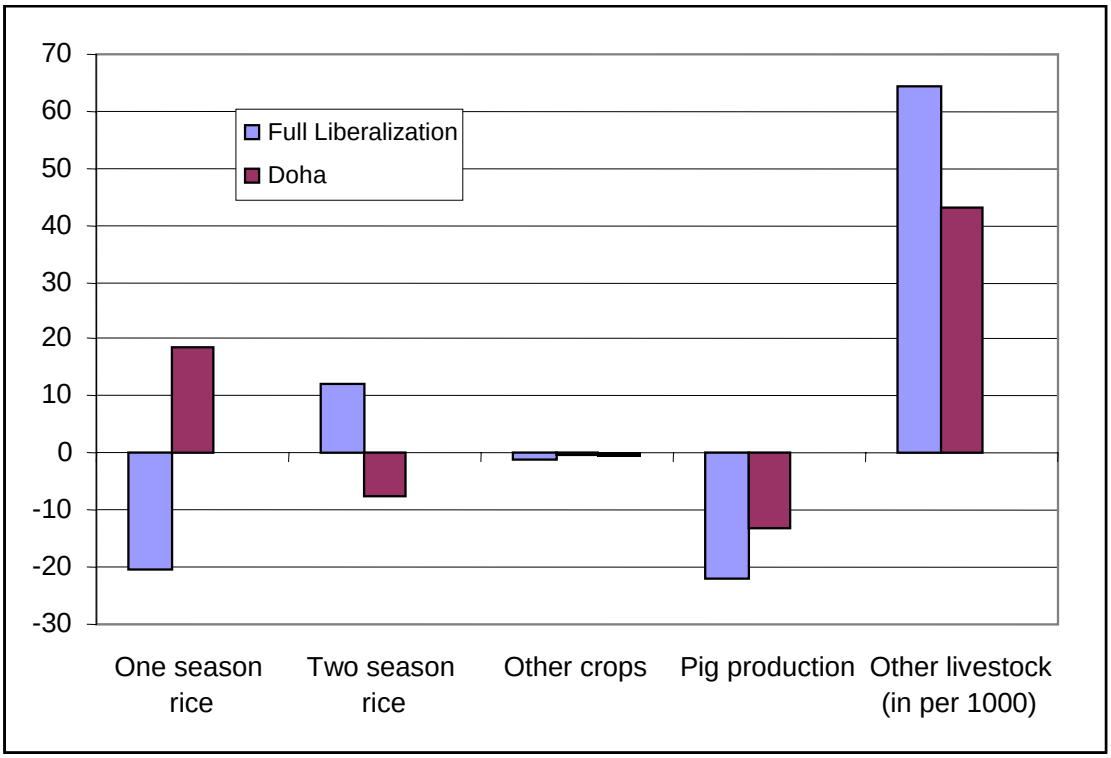


Table 1: Shocks administered to village model (% change with respect to base)

	Full liberalization		*Doha*	
	Prices (A)	**Employment (B)**	**Prices (A)**	**Employment (B)**
Agricultural outputs				
One-season rice	7.4	-	1.3	-
Two-season rice	7.4	-	1.3	-
Other crops	4.1	-	1.1	-
Pigs	5.0	-	1.3	-
Other livestock	5.0	-	1.3	-
Agricultural inputs				
Fertilizer	0.6	-	0.2	-
Herbicides	0.6	-	0.2	-
Pesticides	0.6	-	0.2	-
Seed	5.1	-	1.3	-
Purchased feed	5.1	-	1.3	-
Other inputs	0.9	-	0.3	-
Consumption goods				
Food	3.3	-	0.9	-
Processed food	3.3	-	0.9	-
Nonfood	1.8	-	0.6	-
Durables	0.0	-	0.0	-
Other expenditures	1.8	-	0.6	-
Wages				
Non-agricultural employment	-	2.2	-	0.7
Migration, inside province	-	2.2	-	0.7
Migration, outside province	-	0.6	-	0.3
Outside village employment				
Non-agricultural employment	-	1.8	-	1.5
Migration, inside province	-	1.8	-	1.5
Migration, outside province	-	2.2	-	1.9

Note: complete liberalization applies a combined shock of prices and employment (*i.e.* scenario A+ scenario B).

Table 2: Activities and income by household group

	Link outside province:	*No link*		*Link*		*Village*
	Owning draught power:	*No*	*Yes*	*No*	*Yes*	
	N=	*78*	*100*	*256*	*295*	*729*
Composition of activities (% value added)						
Agriculture	One-season rice	9.4	10.8	8.2	10.5	9.5
	Two-season rice	28.5	28.2	18.6	27.1	23.9
	Other crops	21.2	24.7	18.4	22.4	20.9
	Cattle	-	7.5	-	8.1	4.1
	Pigs	0.1	0.1	0.2	0.4	0.3
	Other livestock	0.1	0.1	0.0	0.0	0.0
Village employment	Agricultural labor	1.3	2.2	-	0.1	0.4
	Local business	19.4	13.5	2.4	2.7	5.2
Outside village	Outside employment	18.0	12.9	9.1	5.4	8.9
Migration	Inside province	2.1	-	4.2	0.9	2.3
	Outside province	-	-	38.8	22.3	24.6
		100	*100*	*100*	*100*	*100*
Sources of household income (% total income)						
Labor	Shadow wage income	57.4	52.8	52.6	62.1	57.4
	Above shadow wage income	17.5	12.3	23.3	6.0	13.5
Land	Irrigated land shadow income	12.4	13.3	12.8	11.4	12.1
	Irrigated land, above shadow income	4.8	6.5	1.4	4.5	3.7
	Non-irrigated land	7.3	7.9	7.7	6.6	7.2
Capital	Cattle	-	3.3	-	3.1	1.8
	Tractor	-	1.6	-	0.8	0.6
Transfer	Within village transfers	0.6	0.3	0.0[1]	0.5	0.3
	Receipts from outside village	0.0	1.9	2.2	5.0	3.3
		100	*100*	*100*	*100*	*100*
Income per adult consumer equivalent						
Annual income in 1,000 yuan		2.2	2.3	3.0	2.7	2.7
Income in US dollar per day		1.5	1.6	2.1	1.9	1.8

Note: '-' indicates that the household is not involved in this activity

Table 3a: Substitution elasticities for cropping activities (village average)

	Land	*Labor*	*Animal traction*	*Tractor*	*Other inputs*
One-season rice					
Labor	0.39				
Animal traction	0.39	1.87			
Tractor	0.39	1.87	79.21		
Other inputs	1.72	2.09	2.09	2.09	1.84
Two-season rice					
Labor	0.66				
Animal traction	0.66	0.66			
Tractor	0.66	0.66	53.65		
Other inputs	0.98	0.98	0.98	0.98	1.35
Other crops					
Labor	0.33				
Animal traction	0.33	2.88			
Tractor	-	-	-		
Other inputs	0.57	1.41	1.41	-	1.06

Note: elasticities as well as the structure of the production functions are calibrated with the survey data, for details see Kuiper (2005); because of differences in cost shares, substitution elasticities vary slightly household group.

Table 3b: Substitution elasticities for livestock activities (village average)

	Labor	*Crop residues*	*Purchased feed*
Pigs			
Crop residues	1.53		
Purchased feed	1.53	1.53	
Other inputs	1.53	1.53	1.49
Other livestock			
Crop residues	0.87		
Purchased feed	0.87	0.87	
Other inputs	0.87	0.87	0.87

Note: elasticities as well as the structure of the production functions are calibrated with the survey data, for details see Kuiper (2005); because of differences in cost shares, substitution elasticities vary slightly household group.

Table 4: Household production and marketed surplus with Full Liberalization scenario A[1/]
(% change)

	Link outside province:	*No link*		*Link*		*Village*
	Owning draught power:	*No*	*Yes*	*No*	*Yes*	
Production:						
Crops	One season rice	-18.8	90.3	-46.6	-67.4	-31.8
	Two season rice	8.5	-32.5	23.6	32.7	17.3
	Other crops	-1.1	-1.9	0.0	-1.7	-1.1
Livestock	Pig production	-31.1	-83.8	-5.2	-24.6	-22.9
	Other livestock	432.1	3093.4	56.5	367.6	650.0
Marketed surplus:						
Crops	One season rice	-39.5	125.6	-90.6	-100.0	-52.4
	Two season rice	19.4	-100.0	68.0	91.7	45.4
	Other crops	-72.7	-36.4	0.4	-23.0	-16.1
Livestock	Pig production	-32.9	-100.0	-5.8	-38.6	-27.9
	Other livestock	946.4	6539.5	207.1	1187.0	1923.5

[1/] Scenario Full Liberalization A = exogenous price changes to agricultural outputs, inputs and consumption goods.

Table 5: Household production and marketed surplus with Full Liberalization scenario B[1/]
(% change)

	Link outside province:	*No link*		*Link*		*Village*
	Owning draught power:	*No*	*Yes*	*No*	*Yes*	
Production:						
Crops	One season rice	-1.4	-0.3	1.2	37.2	17.3
	Two season rice	0.3	0.2	-0.4	-16.2	-7.7
	Other crops	-0.1	-0.1	-0.3	-0.1	-0.1
Livestock	Pig production	1.0	1.9	1.3	-1.6	0.5
	Other livestock	-15.4	-47.0	-9.4	52.4	4.0
Marketed surplus:						
Crops	One season rice	-3.7	-0.6	2.4	54.6	27.9
	Two season rice	-0.3	-0.1	-1.2	-47.9	-22.1
	Other crops	-17.6	-1.8	-1.1	-0.8	-1.3
Livestock	Pig production	1.0	2.2	1.4	-2.5	0.6
	Other livestock	-34.7	-100.0	-34.4	169.9	11.6

[1)] Scenario Full Liberalization B = exogenous increase in off-farm employment.

Table 6: Household production and marketed surplus with Full Liberalization scenario [1/]
(% change)

	Link outside province:	*No link*		*Link*		*Village average*
	Owning draught power:	*No*	*Yes*	*No*	*Yes*	
Production:						
Crops	One season rice	-22.8	90.7	-42.0	-45.0	-20.4
	Two season rice	9.7	-32.1	21.5	23.0	12.3
	Other crops	-1.2	-2.1	-0.2	-1.5	-1.1
Livestock	Pig production	-30.5	-83.7	-4.2	-22.8	-21.8
	Other livestock	419.8	3088.5	48.0	360.3	642.0
Marketed surplus:						
Crops	One season rice	-48.5	125.9	-81.6	-67.5	-34.1
	Two season rice	21.2	-100.0	62.0	61.9	30.5
	Other crops	-91.3	-40.1	-0.6	-23.8	-17.7
Livestock	Pig production	-32.3	-100.0	-4.7	-36.2	-26.7
	Other livestock	918.6	6528.3	175.9	1162.1	1898.9

[1/] Scenario Full Liberalization = exogenous changes in prices (A) and exogenous increase in off-farm employment (B).
Note: (*i*) indicates an identical impact of price and employment components of full trade liberalization; (*p*) indicates that the price component of full trade liberalization dominates household response; (e) indicates that the employment component of full trade liberalization dominates household response.

Table 7: Equivalent variation per adult equivalent by household group (yuan) and as percentage of base adult equivalent income

Link outside province:	*No link*		*Link*		*Village average*
Owning draught power:	*No*	*Yes*	*No*	*Yes*	
Full trade liberalization					
Prices	378	752	199	601	465
	17%	33%	7%	22%	17%
Employment	59	29	123	47	71
	3%	1%	4%	2%	3%
Prices and employment	441	806	321	702	563
	20%	35%	11%	26%	21%
Doha					
Prices	80	166	42	105	90
	4%	7%	1%	4%	3%
Employment	33	16	90	34	50
	1%	1%	3%	1%	2%
Prices and employment	121	168	131	133	136
	5%	7%	4%	5%	5%

Note: a yuan is about 0.25 dollar cents; adult equivalents are corrected for the absence of migrants

Table 8: Contribution of price changes and employment to income gains

Link outside province:	*No link*		*Link*		*Village average*
Owning draught power:	*No*	*Yes*	*No*	*Yes*	
Full trade liberalization					
Prices	86%	93%	62%	86%	83%
Employment	13%	4%	38%	7%	13%
Interaction effects	1%	3%	0%	8%	5%
Total	100%	100%	100%	100%	100%
Doha					
Prices	66%	99%	32%	79%	66%
Employment	27%	10%	69%	26%	37%
Interaction effects	7%	-8%	-1%	-5%	-3%
Total	100%	100%	100%	100%	100%