Household Welfare Impacts of China’s Accession to the World Trade Organization

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Abstract: We use China’s national household surveys for rural and urban areas to measure and explain the welfare impacts of the changes in goods and factor prices attributed to WTO accession. The price changes are estimated separately, using a general equilibrium model to capture both direct and indirect effects of the initial tariff changes. The welfare impacts are first-order approximations based on a household model incorporating own-production activities and are calibrated to the household-level data imposing minimum aggregation. We find negligible impacts on inequality and poverty in the aggregate. However, there are diverse impacts emerge across household types and regions associated with heterogeneity in consumption behavior and income sources, with possible implications for compensatory policy responses.


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1 Tamar Manuelyan-Atinc and Will Martin were instrumental in encouraging us to undertake this task, and we have had many useful discussions with them along the way. Elena Ianchovichina and Will Martin provided the estimates of the price impacts of China’s trade reform that are crucial to this study, and we had many helpful discussions with them. Pingping Wang, Yan Fang, Liqun Peng, Honge Gong and Min Yuan helped greatly in matching variables from China rural/urban household surveys to the categories of general equilibrium model. The comments of François Bourguignon, John Cockburn, Neil McCulloch, Sangui Wang and participants at the Fourth Asian Development Forum, Seoul, and the National Bureau of Statistics, Beijing, are gratefully acknowledged. Email addresses: schen@worldbank.org and mravallion@worldbank.org.
1. Introduction

There has been much debate about the welfare impacts of greater trade openness. Some argue that external trade liberalizations are beneficial to the poor in developing countries while others have argued that the benefits will be captured more by the non-poor. Expected impacts on relative wages (notably between skilled and unskilled labor) and relative prices (such as between food staples and luxury imports) have figured prominently in assessments of the welfare impacts.

What does the evidence suggest? One might hope to be able to provide a conclusive answer by comparing changes over time in measures of inequality or poverty between countries that are open to external trade and countries that are not. A number of attempts to throw empirical light on the welfare effects of trade liberalization have been made using aggregate cross-country data sets, whereby levels of measured inequality or changes over time in measured inequality and/or poverty are combined with data on trade openness and other control variables.²

However, there are reasons to be cautious in drawing implications from such studies. There are concerns about data and econometric specification. Differences in survey design and processing between countries, and over time within countries, can add considerable noise to the measured levels and changes in inequality. It is unclear how much power cross-country data sets have for detecting any underlying effects of greater openness or other covariates. There is also an issue as to whether the volume of trade can be treated as exogenous in these cross-country regressions; it is clearly not a policy variable as such and it may well be highly correlated with other (latent) attributes of country performance independently of trade policy. The attribution of inequality impacts to trade policy reforms per se is clearly problematic.

One way in which the correlations (including lack of correlation) found in these studies can be deceptive is because starting conditions vary a lot between reforming countries.

Averaging across this diversity in initial conditions can readily hide systematic effects of relevance to policy. For example, countries differ in their initial level of economic development. It has been argued that greater openness to external trade will have very different effects on inequality depending on the level of economic development — increasing inequality in rich countries and decreasing it in poor ones (Wood, 1994, makes a qualified argument along these lines.) However, the opposite outcome is possible when economic reforms, including greater openness to external trade, increase demand for relatively skilled labor, which may well be more unequally distributed in poor countries than rich ones. There is some evidence of a negative interaction effect between openness to trade and initial GDP per capita in regressions for inequality across countries (Barro, 2000; Ravallion, 2001; Milanovic, 2002).

These problems can be dealt with by introducing suitable nonlinearities (including interaction effects) into the regressions based on compilations of country aggregates. However, the relevant sources of heterogeneity go much further than this. Aggregate inequality or poverty may not change with trade reform even though there are both gainers and losers at all levels of living. In cases in which the survey data have tracked the same families over time, it is quite common to find considerable churning under the surface. One can find that many people have escaped poverty while others have fallen into poverty, even though the overall poverty rate may move rather little. Numerous sources of such diverse impacts can be found in developing country settings. For example, geographic disparities in access to human and physical infrastructure between and within developing countries matter to the prospects for participating in the growth generated by reform, and these disparities tend to be correlated with incomes (in the context of China’s lagging poor areas see Jalan and Ravallion, 2002). In the case of China, the economic geography of poverty and how this interacts with the geographic diversity in the

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impacts of policy reforms, is high on the domestic policy agenda. A policy analysis that simply averaged over such differences would miss a great deal of what matters to the debate on policy. Reforms may well entail sizable redistribution between the poor and the rich, but in opposite directions in different countries or different regions within countries. One should not be surprised to find that there is zero correlation between growth and changes in inequality, or that the average impact of policy reform on inequality is not significantly different from zero. Yet there could well be non-random distributional changes going on under the surface of this average impact calculation. Thus claims made about the distributional impacts of trade reform using cross-country comparisons are of questionable relevance for policy in any specific country.

This paper follows a different approach for which the attribution to trade policy changes is unambiguous and the diversity of welfare impacts is not lost. We study the welfare impacts at household level of the relative price changes induced by a specific trade policy reform. The trade reform we study is China’s accession in 2001 to the World Trade Organization. This meant a sharp reduction in tariffs, quantitative restrictions and export subsidies, with implications for the domestic structure of prices and wages and hence household welfare.

Past approaches to studying the welfare impacts of specific trade reforms have tended to be either partial equilibrium analyses, in which the welfare impacts of the direct price changes due to tariff changes are measured at household level, and general equilibrium analyses, in which second-round responses are captured in a theoretically consist way but with considerable aggregation across household types. In general terms, the economics involved in both approaches is well known. And both approaches have found numerous applications.

We combine these two approaches. In particular, the price changes induced by the trade-policy change are simulated from a general equilibrium model, which we then carry to large

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4 For an overview of alternative approaches to accessing the welfare impacts of trade-policies see McCulloch et al., (2001).
national household surveys for urban and rural areas of China. However, the CGE and household-level analyses are not integrated, which would require (in effect) an extraordinarily high dimensional CGE model in our case (with 85,000 households in the survey). While, we build our micro simulations on economic assumptions that are consistent with the CGE model — notably that households take prices as given and those prices clear all markets — we do not attempt to assure full consistency between the micro-analysis and the CGE model’s predictions.

Nonetheless, our approach respects the richness of detail available from a modern integrated household survey, allowing us to go well beyond the highly aggregative types of analysis one often finds. We not only measure expected impacts across the distribution of initial levels of living, but we also look at how they vary by other characteristics, such as location. We are thus able to provide a reasonably detailed “map” of the predicted welfare impacts by location and socio-economic characteristics.

The following section discusses our approach in general terms. We then describe our data in section 3 and our results in section 4. Section 5 attempts to explain the variance in measured impacts in terms of household characteristics. Our findings are reviewed in section 6.

2. Measuring the welfare impacts of trade reform

We study a specific trade reform in a single developing country, namely China’s accession to the World Trade Organization. Drawing on prior estimates of the impacts of that reform on prices (for both commodities and factors of production), as reported in Ianchovichina and Martin (2002), we apply standard methods of first-order welfare analysis to measure the gains and losses at household level using large sample surveys for China collected by the National Bureau of Statistics.
The general equilibrium analysis generates a set of price and wage changes; these embody both the direct price effects of the trade-policy change and “second-round” indirect effects on the prices of non-traded goods and on factor returns, including effects operating through the government’s budget constraint. The model used by Ianchovichina and Martin (2002) is a model from the Global Trade Analysis Project (GTAP). This is a competitive market-clearing model. The revenue implications of the trade-policy change are reflected in changes in indirect tax rates. A full discussion of the assumptions of the general equilibrium model and the results of its application to China’s accession to the WTO can be found in Ianchovichina and Martin (2002).

Note that since the price changes are based on an explicit model, their attribution to the trade-policy reform is unambiguous. So we do not confront the identification problems common to past attempts to estimate distributional effects of trade-policy reform using cross-country comparisons, as discussed in the introduction.

The specifics of our approach can be outlined as follows. Each household has preferences over consumption and work effort represented by the utility function \( u_i(q^d_i, L_i) \) where \( q^d_i \) is a vector of the quantities of commodities demanded by household \( i \) and \( L_i \) is a vector of labor supplies by activity, including supply to the household’s own production activities. (Commodities have positive marginal utilities while labor supplies have negative marginal utilities.) The household is assumed to be free to choose its preferred combinations of \( q^d_i \) and \( L_i \) subject to its budget constraint. Consistently with the general equilibrium model that generated the price and wage changes, we assume that there is no rationing at household level; for example, involuntary unemployment is ruled out.

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5 Papers describing the standard GTAP with applications can be found in Hertel (1997).
For calculating the monetary value of the welfare impact of price and wage changes, we work with the standard indirect utility function of household $i$ as given by:

$$
v_i[p_i^d, w_i, \pi_i] = \max_{(q_i^d, L_i)} [u_i(q_i^d, L_i) | p_i^d q_i^d = w_i L_i + \pi_i]$$

(1)

where $p_i^d$ is the price vector for consumption, $w_i$ is the vector of wage rates and $\pi_i$ is the profit obtained from all household enterprises as given by:

$$\pi_i(p_i^s, p_i^d, w_i) = \max_{(z_i, L_i)} [p_i^s q_i^s - p_i^d z_i - w_i L_i | q_i^s = f_i(z_i, L_i)]$$

(2)

where $p_i^d$ is the vector of supply prices, $q_i^s$ is the vector of quantities supplied, $L_i$ is the labor input to the own production activities, $f_i$ is the household-specific production function (embodied fixed factors) and $z_i$ are quantities of commodities used as production inputs.

We take the predicted price and wage impacts from the CGE model as given for the analysis of household-level welfare impacts. In measuring the welfare impacts we are constrained of course by the data, which do not include initial price and wage levels. However, this data limitation does not matter to calculating a first-order approximation to the welfare impact in a neighborhood of the household’s optimum. Taking the differentials of equations (1) and (2) and using the envelope property (whereby the welfare impacts in a neighborhood of an optimum can be evaluated by treating the quantity choices as given), the gain to household $i$ (denoted $g_i$) is given by the money metric of the change in utility:

$$g_i \equiv \frac{du_i}{v_i} = \sum_{j=1}^{m} \left[ p_{ij}^s q_{ij} \frac{dp_{ij}^s}{p_{ij}^s} - p_{ij}^d \frac{dp_{ij}^d}{p_{ij}^d} \right] + \sum_{k=1}^{n} \left( w_k L_{ik} \frac{dw_k}{w_k} \right)$$

(3)

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6 For food items we can calculate unit values (expenditure divided by quantity) from the survey data, but there is no such option for food inputs to production, non-food commodities consumed or used in production or wages (given that the survey data do not include labor supplies or quantities consumed of nonfood goods including production inputs).
where \( v_{ni} \) is the marginal utility of income for household \( i \) (the multiplier on the budget constraint in equation 1) and \( L_{iik} = L_{ik} - L_{iik}^0 \) is the household’s “external” labor supply to activity \( k \). (Notice that gains in earnings from labor used in own production are exactly matched by the higher cost of this input to own-production.) The proportionate changes in all prices and wages are weighted by their corresponding expenditure and income shares; the weight for the proportionate change in the \( j \)’th selling price is \( p_{ij}^s q_{ij}^s \), the revenue (selling value) from household production activities in sector \( j \); similarly \( -p_{ij}^d (q_{ij}^d + z_{ij}) \) is the (negative) weight for demand price changes and \( w_k L_{iik}^s \) is the weight for changes in the wage rate for activity \( k \). We will refer to the term \( p_{ij}^s q_{ij}^s - p_{ij}^d (q_{ij}^d + z_{ij}) \) as “net revenue” which (to a first-order approximation) gives the welfare impact of an equi-proportionate increase in the price of commodity \( j \).

Equation (3) is the key formula we will use for calculating the welfare impacts at household level. Notice that by applying the calculus in deriving (3) we are implicitly assuming small changes in prices and earnings. Relaxing this requires more information on the structure of the demand and supply system; see for example Ravallion and van de Walle (1991). This would entail considerable further effort, and the reliability of the results will be questionable given the aforementioned problem of incomplete price and wage data.

For the same reason, we will have little choice but to largely ignore geographic differences in the prices faced, or in the extent to which border price changes are passed on locally. The exception is that we will make a seemingly plausible allowance for urban-rural cost-of-living differences in this setting.
3. Setting and data

While the official date of China’s WTO accession is 2001, it is clear that the Chinese economy had already started to adapt to this expected change. We can thus think of the trade reform as having two stages, a lead-up period in which tariffs started to fall in anticipation of WTO accession and the period 2001 onwards. Ianchovichina and Martin (2002) argue that the one can identify 1995 as a plausible beginning of the lead-up period to WTO accession. We will use their estimates of the price changes induced by WTO accession for the periods 1995-2001 and 2001-07. While the primary focus of the discussion will be on the latter period, we will also estimate welfare impacts for the lead-up period.

We will calibrate the welfare impacts to survey data for 1999, two years prior to official WTO accession, and a few years after the likely beginning of the lead-up period. The choice of 1999 was partly made for data reason (notably that this was the most recent year for which we could obtain access to the micro data). However, it is also hoped that by choosing a year near the middle of the lead-up period (rather than a survey at the beginning or end) we might diminish possible biases due to any nonlinearity in the welfare impacts of price and wage changes.

The survey data used in this study are from the 1999 Urban Household Survey (UHS) and the 1999 Rural Household Survey (RHS), both done by China’s National Bureau of Statistics (NBS). The RHS sample size is 67,900 households and 16,900 for the UHS. Over the past 15 years, NBS has put a great effort to improve both the RHS and UHS, focusing on sample coverage, questionnaire design, survey methodology and data processing. The number of variables in the surveys has increased dramatically with additional details on income, expenditure, savings, housing, productivity, amongst other things. NBS kindly provided us with

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7 The full sample of the UHS in 1999 was about 40,000 households. However, the central office only keeps the individual record data for 16,900 households. Since 2002 the central office keeps all 40,000 households’ data.

8 For further discussion in the context of the RHS see Chen and Ravallion (1996).
the micro data for three provinces (Liaoning, Guangdong and Sichuan), which we term the “test provinces.” The computer program to implement our estimation method was written for these data, after which the program was run by NBS staff on the entire national data set.

However, a number of problems still remain in the 1999 RHS and UHS. For its sample frame, the RHS relies on its sampled counties from 1985. The UHS excludes the rural migrants, since the base of the UHS sample frame is the legal registration system (Hukou). As in other countries, the RHS gives data on the remittances of migrants workers, but does not provide information about the migrant workers themselves, who (unlike in other countries) are not sampled in the urban survey either. This makes it difficult to measure impacts through labor mobility and rural-urban transfers in this study.

Comparisons between the RHS and UHS also pose problems. For example, income in the RHS includes income in-kind (such as from own-farm production and other household enterprises), but income in the UHS ignores some in-kind components, notably subsidies received from the government.

**Sampling weights.** According to the population census, the 1999 urban population share is 34 percent. As already noted, we only have part of the urban sample and the sample-based urban population share is 20 percent. For correcting the rural and urban sampling weights, we use the urban population share from the China Statistical Yearbook to replace the survey sample weights in forming the national figures in this study.

**Matching between the GTAP model and the surveys.** There are 57 sectors in the GTAP model. The China GTAP model used in this study regroups these 57 sectors into 25 categories: rice, wheat, feed grains, vegetables and fruits, oilseeds, sugar, plant fibers, livestock and meat, dairy, processed food, beverages and tobacco, extract, textiles, apparel, light manufactures, petrochemicals, metals, automobiles, electronics, other manufactures, trade and transport,
construction, communications, commercial services and other services. China’s RHS and UHS have approximately 2000 categories for consumption and production. We have matched the variables from the household surveys into the closest category in GTAP. For example, corn, millet, and potato are placed in category 3 (feed grains); cotton and fiber crop in category 7 (plant based fibers). The Appendix (Table A2) gives more detailed information on how the variables from RHS and UHS are matched with the GTAP sectors.

Definitions of labor and labor earnings. The China GTAP model defines three types of labor: unskilled farm labor, unskilled non-farm labor and skilled non-farm labor. Since the RHS and UHS have different questionnaires, rural and urban labor earnings are treated differently. In the UHS, three variables — sector, occupation or education — were used to determine labor types. The Appendix gives the codes used by the UHS. “Sector” or “occupation alone cannot tell us whether a person should be classified as skilled labor. For example, the financial sector may hire unskilled labor while the services sector may hire skilled labor. (A janitor who works at a bank will be placed in the financial sector even though he is really classified as unskilled labor.) Similarly, a train driver in the occupation category “workers and staff-members in production and transportation” counts as skilled labor. Therefore, we also take account of education. If a worker has received education at the senior high school level or above, he or she is considered skilled labor. Otherwise, he is classified as unskilled labor.

It is more difficult to determine the type of labor income for rural areas since there is no individual income in the RHS. Although we have every household member’s education record, we have no information on how much each person earns and from what work. Consequently, labor earnings can only be classified roughly by income source. For instance, all labor

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9 By the International Labor Organization’s definitions, “skilled labor” consists of managers and administrators, professionals, and para-professionals, while “unskilled labor” comprises trades-persons, clerks, salespersons and personal service workers, plant and machine operators and drivers, laborers and related workers and farm workers.
remuneration from agriculture is considered income from unskilled farm labor; earnings from industry and/or construction, grain processing etc., are considered as income from unskilled non-farm labor; earnings from the tertiary sector, transportation and trade etc. are considered as income from skilled non-farm labor.

**Land and capital.** Since China’s economic reforms started in 1978, every farmer has land use rights but not the right to sell, although she/he can subcontract the allocated land to another farmer. Therefore, the change of land prices from the GTAP model only affects the value of land rentals paid and received.

We end up with 25 groups of production and consumption activities, plus “land” and “capital” and three types of labor — farm unskilled, non-farm unskilled and skilled labor.

In the urban household survey, own production is zero for all households and every category. For rural areas, the calculation is more complicated. We use category 3 “other grain” as an example. For every household $i$, $p^s_i q^s_i$ relates to the cash income from the productions of corn, millet, potato etc.,; $p^d_i q^d_i$ relates to the cash expenditures on these items. (We can exclude the impacts on consumption from own production since the gains and losses automatically cancel out for this part of family consumption.) $p^d_i z_{i3}$ is the production cost related to category 3. The production cost includes seeds, fertilizer etc., but only seeds count in this category, fertilizer is considered in the category “petrochemical industry”.

In four cases, we could not distinguish the cash expenditure for an individual item from the total cash consumption. We then assigned cost to each item proportionally. For example, if millet consumption is 10% of grain consumption, then we assume that the cash expenditure on millet is also 10% of cash expenditure on grain.
In assessing the overall impacts on poverty and inequality, we combine rural and urban households. There is no cost-of-living index between urban and rural areas of China. (The urban and rural CPIs are both indexed to 100 at the base date.) We assume that the urban price level is 15% higher than the rural one. We deliberately set this to a lower level than other developing countries given that subsidies to urban households in China help compensate for higher housing and food costs than found in rural areas.) We then rank all households by their per capita income from the poorest to the richest.

In assessing impacts on inequality and poverty, we use income per person as the welfare indicator; this is what is termed “net income” in the RHS and “disposable income” in the UHS. Post-reform income is then income plus the estimated gain defined by equation (3).

4. Measured welfare impacts of WTO accession

Tables 1a and b give the predicted relative prices and wage changes in China during the two periods, 1995-2001 and 2001-07 (respectively), as obtained from the China GTAP model of Ianchovichina and Martin (2002). The tables also give the mean net revenue for each of urban and rural areas, based on the 1999 rural and urban household surveys.

Based on the relative price changes from the GTAP model and production/consumption shares from the 1999 rural/urban household survey data, equation (3) allows us to compute the net gain for each household. Table 2 summarizes the results. The first panel gives the mean gains for each of the periods 1995-2001 and 2001-07, split by urban and rural areas. The second panel gives the Gini indices, both actual (for the baseline year, 1999) and simulated. The two simulated income distributions are obtained by (in one case) subtracting the estimated gains over 1995-2001 from the 1999 incomes at household level and (in the other) adding the household-specific gains from 2001-07 to the 1999 incomes. Thus the first simulation tells us the
distributional impact of the price changes during the first stage of the trade reform (i.e., what the baseline distribution would have looked like without the reforms) while the second tells us the impact of the post-2001 price changes (i.e., how those changes are expected to impact on the baseline distribution, looking forward). The third panel gives the headcount index of poverty for various poverty lines; the “official line” gives our estimates based on the poverty lines used by NBS, while the “$1/day” and $2/day” lines are those from Chen and Ravallion (2001).

We find an overall gain of about 1.5% of mean income. All of this is in the period leading up to actually joining the WTO. We find almost no impact on inequality, either in the period leading up to WTO accession or predicting forward. The aggregate Gini index increased slightly, from 39.3% without WTO accession to 39.5% post-WTO.

We find that the incidence of poverty would have been slightly higher in 1999 if not for the trade policy changes over the lead-up period to WTO accession, while we find a slight increase in poverty due to the expected price changes induced by the remaining tariff changes from 2001 to 2007. The impacts on poverty for a wide range of poverty lines can be seen from Figures 1a and 1b, which give the cumulative distributions of income for both the baseline and the two simulated distributions for the poorest 60% in rural areas and 40% in urban areas.

Let us now disaggregate these results. We will focus on the results predicting forward from WTO accession. As we have seen there is virtually zero aggregate impact.

We focus on three indicators of impact at the household level: the absolute gain or loss \( (g_i) \), the proportionate gain or loss \( (g_i / y_i) \) and whether the gain is positive or not \( (I(g_i)) \) where \( I \) is the indicator function). Our interest in the first two measures is obvious enough. We include the third to help determine where there might be high concentrations of losers, in specific areas or socio-economic groups.
Tables 2a and 2b give the average gain or loss by province for urban and rural areas respectively, and the number of gainers in each case. In Figure 2a,b and c we plot the results by provinces ranked by mean income per person (Table A4 in the Appendix gives the province rankings); Figure 2a gives mean absolute gains (\( g_i \) in Yuan per capita), Figure 2b gives proportionate gains (\( g_i / y_i \) as a percentage) while Figure 2c gives the proportion of households who registered positive gains. In Figure 3 we give the same results plotted this time against percentiles of the income distribution (so, for example, to see the mean impact in Yuan per capita at the median income one looks at the 50\(^{th}\) percentile of Figure 3a). (Notice that Figure 3a gives the horizontal differences in Figures 1a,b plotted against the point on the vertical axis.)

In the aggregate, about three-quarters of rural households and one tenth of urban residents experience a real income loss. Farm income is predicted to drop by 18 Yuan per person while urban per capita income rises by 29 Yuan. Looking at the breakdown by categories in Table 1b, we find that the decline in rural income is due to the drop of wholesale prices for most farm products, plus higher prices on education and health care. On the other hand, farmers will benefit from the drop in some consumer prices. They will also benefit from the increase of non-farm labor wages. In urban areas, residents will enjoy lower prices for most farm products and higher wages, but they will also be hit by increases in service fees for education and health care.

Turning to the regional breakdown in Tables 3a,b and Figures 2a-c, we see a quite different impacts across regions. The mean absolute gains tend to be highest amongst the richest provinces in both urban and rural areas (Figure 2a) though there is no correlation between proportionate gains and mean income of the province (Figure 2b). One spatially contiguous region stands out as having the largest loss from the reform, namely the northeast provinces of Heilongjiang, Jilin, Inner Mongolia and Liaoning. Both absolute and proportionate impacts are
highest in this region — indeed, more than 90 percent of farmers in Heilongjiang and Jilin are predicted to experience a net income loss.

Notice that these geographic differences in welfare impacts arise entirely from differences in consumption and production behavior. In reality, there are also likely to be differential impacts on local prices, due to transport or other impediments to internal trade. Our approach does not incorporate such differences, and doing so would pose a number of data and analytic problems. This might, however, be a fruitful direction for future work in settings in which one has the necessary data on prices and wage levels by geographic area.

When we rank households by initial income we find a notable difference between urban and rural households, with absolute gains tending to be higher for higher income households in urban areas, but lower for higher income households in rural areas (Figure 3a). Nationally (combining urban and rural areas with the corrected weights discussed above), we find a hint of a U shaped relationship, though still with the highest absolute gains for the rich.

This flips when we look at the proportionate gains (Figure 3b). This tends to fall as income rises in urban areas, but rise with income in rural areas and nationally. In the aggregate, one finds a higher proportion of gainers as one moves up the income ladder, which is driven by the rise in number of gainers as income increases within rural areas (Figure 3c).

5. Explaining the incidence of gains and losses

The way we have formulated the problem of measuring welfare impacts in section 3 allows utility and profit functions to vary between households at given prices. To try to explain the heterogeneity in measured welfare impacts we can suppose instead that these functions vary with observed household characteristics. The indirect utility function becomes:

\[
v_i(p_i^d, w_i, \pi_i) = v(p_i^d, w_i, \pi_i, x_{ii}) = \max[u(q_i^d, L_i, x_{ii}) | p_i^d q_i^d - w_i L_i = \pi_i]
\]  

(4)
where
\[
\pi_i = \pi(p_i^s, p_i^d, w_i, x_{2i}) = \max[p_i^s f(z_i, L_i^o, x_{2i}) - p_i^d z_i - w_i L_i^o]
\] (5)

Note that we allow the characteristics that influence preferences over consumption \(x_{1i}\) to differ from those that influence the outputs from own-production activities \(x_{2i}\).

The gain from the price changes induced by trade reform, as given by equation (3), depends on the consumption, labor supply and production choices of the household, which depend in turn on prices and characteristics, \(x_{1i}\) and \(x_{2i}\). For example, households with a higher proportion of children will naturally spend more on food, so if the relative price of food changes then the welfare impacts will be correlated with this aspect of household demographics. Similarly, there may be differences in tastes associated with stage of the life cycle and education. There are also likely to be systematic covariates of the composition of income.

Generically, we can now write the gain as:
\[
g_i = g(p_i^d, p_i^s, w_i, x_{1i}, x_{2i}) = \sum_{j=1}^{m} p_j^s q_j^s (p_i^d, p_i^s, w_i, x_{2i}) \frac{dp_j^s}{p_j^s} - p_j^d q_j^d (p_i^d, p_i^s, w_i, x_{1i}) + z_{ij} (p_i^d, p_i^s, w_i, x_{2i}) \frac{dp_j^d}{p_j^d} - \sum_{k=1}^{n} w_k [L_{ik} (p_i^d, w_i, \pi_i, x_{1i}) - L_{ik}^o (p_i^d, p_i^s, w_i, x_{2i})] \frac{dw_k}{w_k}
\] (6)

Notice that equations (4) and (5) imply that the gain from reform is inherently non-separable, in that one cannot write it as a function solely of \(p_i^d, x_{1i}\) and \(\pi_i\). This is because the gains also depend on production choices.

However, as noted in section 3, we do not observe the household-specific wages and prices. So we must make further assumptions. In explaining the variation across households in the predicted gains from trade reform we assume that: (i) the wage rates are a function of prices
and characteristics as \( w_i = w(p^d_i, p^s_i, x_{i1}, x_{i2}) \) and (ii) differences in prices faced can be adequately captured by a complete set of county-level dummy variables.

Under these assumptions, and linearizing (6) with an additive innovation error term, we can write down the following regression model for the gains:

\[
g_i = \beta_1 x_{i1} + \beta_2 x_{i2} + \sum_k \gamma_k D_{ki} + \epsilon_i
\]

(7)

where \( D_{ki} = 1 \) if household \( i \) lives in county \( k \) and \( D_{ki} = 0 \) otherwise and \( \epsilon_i \) is the error term.

The characteristics we consider include age and age-squared of the household head, education and demographic characteristics and land (interpreted as a fixed factor of production, since it is allocated largely by administrative means in rural China). We also included dummy variables describing some key aspects of the occupation and principle sector of employment, such as whether the household is a registered agricultural household, whether there is wage employment, whether there is state-sector employment and whether there is participation in a Township and Village Enterprise. We recognize that there are endogeneity concerns about these variables, though we think those concerns are minor in this context, especially when weighed against the concerns about omitted variable bias in estimates that exclude these characteristics.

Under the usual assumption that the error term is orthogonal to these regressors we estimate (6) by Ordinary Least Squares. We estimate the model for urban and rural areas separately in each of the three test provinces for the study (Liaoning, Guangdong and Sichuan) for which we have the complete micro data.

The results are given in Table 4a,b (for rural areas) and 5a,b (urban). (There are some differences in the explanatory variables between urban and rural areas.) We give results for both the absolute gains (\( g_i \)) (Tables 4a,5a) and the proportionate gains (\( g_i / y_i \)) (Tables 4b,5b).

Recall that these are averages across the impacts of these characteristics on the consumption and
production choices that determine the welfare impact of given price and wage changes. This makes interpretation difficult. We view these regressions as being mainly of descriptive interest, to help isolate covariates of potential relevance in thinking about compensatory policy responses.

Looking first at the results for rural areas, we find that the predicted gain from trade reform tends to be larger for larger households in all three provinces. There is also a U-shaped relationship with age of the household head, such that the gains reach a minimum around 50 years of age (47 in Liaoning, 52 in Guangdong and 55 in Sichuan). The gains are lower for agricultural households, higher for households with more employees and TVE workers, higher for those with more migrant workers, higher for those with less cultivated land (though only significant in Liaoning). The only strong demographic effect is that younger households (with a higher proportion of children under six) tend to be gainers in Liaoning. While we do not give the results for the county dummies (to save space), there were significantly higher than average losses in six counties of Liaoning, seven in Guangdong and six in Sichuan. Table 6 gives the mean losses in these counties for agricultural households.

In urban areas, the gains tend to be higher for smaller households (except in Guangdong). As in rural areas, there is a U-shaped pattern (except for Liaoning), with lowest gains at 66 years of age in Guangdong and 51 in Sichuan. While there is no pattern in the relationship between education and the welfare gains in rural areas, the gains in urban areas tend to be larger for less well educated households. However, this may be biased by the fact that we had to use education in identifying skilled labor (noting that unskilled non-farm wages are predicted to increase relative to skilled labor; see Table 2). There are signs of some sectoral effects, though only significantly so in Liaoning, with higher gains for those in government jobs. There are signs of higher gains amongst those whose employer is the government. Retirees tend to have lower gains than others.
6. Conclusions

In the aggregate, we find only a small impact on mean household income, inequality and the incidence of poverty. However, there is still a sizable, and at least partly explicable, variance in impacts across household characteristics. Rural families tend to lose; urban households tend to gain. There are larger impacts in some provinces than others, with highest impacts in the North-East region of Heilongjiang, Jilin, Liaoning and Inner Mongolia. This is a region in which rural households are more dependent on feed grain production (for which falling prices are expected from WTO accession) than elsewhere in China.

Within rural or urban areas of a given province we find that the gains from this trade reform vary with observable household characteristics. The most vulnerable households tend to be in rural areas, dependent on agriculture, with relatively fewer workers and have weak economic links to the outside economy though migration. There are also some strong geographic concentrations of adverse impacts. For example, we find that agricultural households in certain counties incur welfare losses of around 3-5% of their incomes.

Naturally, our approach has its limitations. A case in point is that there may well be dynamic gains from greater trade openness that are not being captured by the model used to generate the relative price impacts; for example, trade may well facilitate learning about new technologies and innovation that brings longer-term gains in productivity. These effects may be revealed better by studying time series evidence, combined with cross-country comparisons.

Another limitation is that we have had little choice here but to make linear approximations in a neighborhood of an initial optimum for each household. In other applications of our method, this may be deceptive if the price or wage changes are large, or the household was initially out-of-equilibrium, such as due to rationing (including involuntary unemployment). In principle there are ways of dealing with these problems by estimating
complete demand and supply systems allowing for rationing. This may prove a fruitful avenue for future research, though it should be noted that these methods generate their own problems, such as arising from incomplete data on price and wage levels at household level.

While acknowledging these limitations, we believe that the type of approach we offer here can still illuminate the likely short-term distributional impacts of economy-wide reforms, with minimum aggregation. Thus the tools used can offer insights for the sorts of policy responses that might be called for to compensate losers from reform.
References


Table 1a: Predicted price changes from GTAP model 1995-2001 and per capita net gain or loss for rural and urban households

<table>
<thead>
<tr>
<th>Expenditures</th>
<th>Wholesale Prices % change</th>
<th>Consumer Prices % change</th>
<th>Rural Mean welfare change</th>
<th>Urban Mean welfare change</th>
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<td>Net revenue Yuan</td>
<td>Mean welfare change</td>
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<td>73.66</td>
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<tr>
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<td>40.86</td>
<td>-0.74</td>
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<td>117.04</td>
<td>2.15</td>
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<td>Vegetables &amp; fruits</td>
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<td>123.41</td>
<td>0.13</td>
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<td>-0.24</td>
<td>-1.04</td>
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<td>0.7</td>
<td>13.74</td>
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<tr>
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<td>0.00</td>
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<td>-500.65</td>
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<td>2.50</td>
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Table 1b: Predicted price changes from GTAP model 2001-07 and per capita net gain or loss for rural and urban households

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<tr>
<th>Expenditures</th>
<th>Wholesale Prices % change</th>
<th>Consumer Prices % change</th>
<th>Rural Net revenue Yuan</th>
<th>Mean welfare change Yuan</th>
<th>Urban Net revenue Yuan</th>
<th>Mean welfare change Yuan</th>
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**Income sources**

<table>
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<tr>
<th>Income sources</th>
<th>Wholesale Prices % change</th>
<th>Consumer Prices % change</th>
<th>Rural Net revenue Yuan</th>
<th>Mean welfare change Yuan</th>
<th>Urban Net revenue Yuan</th>
<th>Mean welfare change Yuan</th>
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<tr>
<td>Farm unskilled labor</td>
<td>-0.3</td>
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Table 2: Summary statistics on aggregate welfare impacts

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<th>National</th>
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<td>(1.54%)*</td>
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<tr>
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<tr>
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<td>39.53</td>
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<tr>
<td><strong>3. Poverty impacts (headcount index, %)</strong></td>
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<td>Official poverty line</td>
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Note: * gives % of mean income
Table 3a: Gain or loss by province; rural areas

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<th>Sampled h'holds</th>
<th>Number of gainers</th>
<th>Original income</th>
<th>Post-WTO income</th>
<th>Gain or loss</th>
<th>Change (%)</th>
<th>% losers</th>
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Table 4a: Regressions for level (Yuan) of gain in rural areas of three provinces

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<td>-1.43</td>
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<td>R-square</td>
<td>0.278</td>
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</table>


Table 4b: Regressions for percentage gains in rural areas of three provinces

<table>
<thead>
<tr>
<th></th>
<th>Liaoning Coefficient</th>
<th>t-ratio</th>
<th>Guangdong Coefficient</th>
<th>t-ratio</th>
<th>Sichuan Coefficient</th>
<th>t-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log of household size</td>
<td>0.768</td>
<td>2.46</td>
<td>0.022</td>
<td>0.20</td>
<td>0.030</td>
<td>0.40</td>
</tr>
<tr>
<td>Age of household head</td>
<td>-0.108</td>
<td>-2.17</td>
<td>-0.007</td>
<td>-0.34</td>
<td>-0.004</td>
<td>-0.31</td>
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<tr>
<td>Squared age</td>
<td>0.001</td>
<td>2.19</td>
<td>0.000</td>
<td>0.40</td>
<td>0.000</td>
<td>-0.02</td>
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<tr>
<td>Agriculture household</td>
<td>-0.896</td>
<td>-2.98</td>
<td>-1.365</td>
<td>-14.85</td>
<td>-1.420</td>
<td>-7.58</td>
</tr>
<tr>
<td># of employee/hh size</td>
<td>0.630</td>
<td>2.76</td>
<td>0.271</td>
<td>2.57</td>
<td>0.444</td>
<td>3.61</td>
</tr>
<tr>
<td># of TVE workers/hh size</td>
<td>0.669</td>
<td>4.27</td>
<td>0.585</td>
<td>4.47</td>
<td>0.548</td>
<td>6.11</td>
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<tr>
<td># of migrate workers/hh size</td>
<td>0.655</td>
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<td>0.187</td>
<td>3.59</td>
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<tr>
<td>Area of cultivated land</td>
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<td>-1.77</td>
<td>0.000</td>
<td>-0.73</td>
<td>0.000</td>
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<td>Area of hilly land</td>
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<td>0.000</td>
<td>-0.35</td>
<td>0.000</td>
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<td>Area of fishpond land</td>
<td>0.000</td>
<td>-0.17</td>
<td>-0.001</td>
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<td>0.000</td>
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<td>Highest education level is</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>… illiterate or semi-illiterate</td>
<td>1.393</td>
<td>2.18</td>
<td>0.507</td>
<td>1.26</td>
<td>-0.013</td>
<td>-0.05</td>
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<td>-0.634</td>
<td>-2.01</td>
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<td>-0.90</td>
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<td>0.06</td>
<td>0.006</td>
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<tr>
<td>… technical school</td>
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<td>-0.229</td>
<td>-1.18</td>
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<tr>
<td>… college (default)</td>
<td>0.456</td>
<td>0.85</td>
<td>0.323</td>
<td>1.81</td>
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<td>-0.71</td>
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<tr>
<td>Ratio of labor force</td>
<td>3.730</td>
<td>3.61</td>
<td>0.461</td>
<td>1.49</td>
<td>-0.169</td>
<td>-0.78</td>
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<tr>
<td>Ratio of children under 6</td>
<td>1.557</td>
<td>1.41</td>
<td>0.173</td>
<td>0.72</td>
<td>-0.275</td>
<td>-1.48</td>
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<tr>
<td>Ratio of children age 6-11</td>
<td>1.625</td>
<td>1.54</td>
<td>-0.477</td>
<td>-1.60</td>
<td>-0.343</td>
<td>-1.85</td>
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<tr>
<td>Ratio of children age 12-14</td>
<td>1.325</td>
<td>1.80</td>
<td>-0.289</td>
<td>-0.91</td>
<td>-0.192</td>
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<tr>
<td>Ratio of children age 15-17</td>
<td>0.788</td>
<td>0.69</td>
<td>-0.709</td>
<td>-1.39</td>
<td>-0.584</td>
<td>-1.68</td>
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<td>R-square</td>
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<td>0.217</td>
<td>0.171</td>
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R-square
Table 5a: Regressions for level (Yuan) of gain in urban areas of three provinces

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<th>Liaoning</th>
<th></th>
<th>Guangdong</th>
<th></th>
<th>Sichuan</th>
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<td>Coefficient</td>
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<td>Coefficient</td>
<td>t-ratio</td>
<td>Coefficient</td>
<td>t-ratio</td>
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<tr>
<td>Log of household size</td>
<td>-5.627</td>
<td>-1.81</td>
<td>5.289</td>
<td>0.27</td>
<td>-19.441</td>
<td>-4.09</td>
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<tr>
<td>Single head h'hold</td>
<td>-1.366</td>
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<td>-37.216</td>
<td>-2.06</td>
<td>-17.369</td>
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<td>Age of household head</td>
<td>0.531</td>
<td>0.92</td>
<td>5.266</td>
<td>2.43</td>
<td>1.542</td>
<td>2.34</td>
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<td>Highest education level (default is university)</td>
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<td>... primary school or lower</td>
<td>13.240</td>
<td>2.95</td>
<td>50.434</td>
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<td>23.079</td>
<td>3.11</td>
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<td>19.104</td>
<td>5.99</td>
<td>56.659</td>
<td>3.58</td>
<td>26.096</td>
<td>4.34</td>
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<td>5.123</td>
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<td>-25.590</td>
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<td>19.351</td>
<td>1.13</td>
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<td>17.773</td>
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<td>-10.816</td>
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<td>8.622</td>
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<td>0.45</td>
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<td>...banking &amp; finance</td>
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<td>0.3</td>
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<td>-1.02</td>
<td>-4.186</td>
<td>-0.33</td>
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<td>...health care etc.</td>
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<td>-1.049</td>
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<td>...education etc.</td>
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<td>-1.64</td>
<td>7.649</td>
<td>0.46</td>
<td>-5.219</td>
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<td>...scientific research</td>
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<td>17.882</td>
<td>1.14</td>
<td>-7.929</td>
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<tr>
<td>...others</td>
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<td>-24.851</td>
<td>-0.75</td>
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<td>Type of employer (default is state owned)</td>
<td></td>
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<tr>
<td>...collective-owned</td>
<td>-1.927</td>
<td>-0.76</td>
<td>11.882</td>
<td>0.54</td>
<td>-5.946</td>
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<td>-10.988</td>
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<td>...private-business owner</td>
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<td>9.448</td>
<td>0.64</td>
<td>10.582</td>
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<td>-14.823</td>
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<td>-0.57</td>
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<tr>
<td>...retirees re-employed</td>
<td>-13.333</td>
<td>-2.45</td>
<td>-35.591</td>
<td>-1.82</td>
<td>-6.752</td>
<td>-0.99</td>
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<td>-49.442</td>
<td>-1.91</td>
<td>-12.218</td>
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<td>-16.796</td>
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<td>Occupation (default is retiree)</td>
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<td>Engineer &amp; technician</td>
<td>10.244</td>
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<td>10.179</td>
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<td>Officers</td>
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<td>17.701</td>
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<td>18.553</td>
<td>0.65</td>
<td>12.734</td>
<td>1.92</td>
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<td>3.380</td>
<td>0.11</td>
<td>4.057</td>
<td>0.5</td>
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<tr>
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<td>Liaoning Coefficient</td>
<td>t-ratio</td>
<td>Guangdong Coefficient</td>
<td>t-ratio</td>
<td>Sichuan Coefficient</td>
<td>t-ratio</td>
</tr>
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<td>---------</td>
<td>------------------------</td>
<td>---------</td>
<td>---------------------</td>
<td>---------</td>
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<td>Log of household size</td>
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<td>0.000</td>
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<td>... primary school or lower</td>
<td>0.524</td>
<td>6.43</td>
<td>0.389</td>
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<td>0.539</td>
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<td>0.583</td>
<td>7.25</td>
<td>0.591</td>
<td>8.27</td>
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<td>... high school</td>
<td>0.180</td>
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<td>0.095</td>
<td>1.46</td>
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<td>1.04</td>
<td>0.015</td>
<td>0.25</td>
<td>0.125</td>
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<td>Sector (default is govt.)</td>
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<td>0.178</td>
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<td>0.79</td>
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<td>0.78</td>
<td>0.081</td>
<td>0.99</td>
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<td>-0.47</td>
<td>0.049</td>
<td>0.53</td>
<td>0.013</td>
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<td>0.14</td>
<td>0.034</td>
<td>0.25</td>
<td>-0.121</td>
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<td>0.019</td>
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<td>-0.08</td>
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<td>0.091</td>
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<td>worker in trans. &amp; telecom. etc.</td>
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Table 6: Average loss for agriculture households in selected counties

<table>
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<tr>
<th>NBS county identifier</th>
<th>Loss in Yuan</th>
<th>Loss in %</th>
<th>Provincial mean in Yuan</th>
<th>Provincial mean in %</th>
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<td>-5.21</td>
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<td>211321</td>
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<td>211322</td>
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<td>440620</td>
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<td>441425</td>
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<td>-12.31</td>
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<td>513021</td>
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</table>

Note: Agriculture household means that more than 75% of income is from agriculture.
### Appendix: Table A1: Sectoral classification used in China GTAP model

<table>
<thead>
<tr>
<th>China GTAP code</th>
<th>GTAP57 code</th>
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<tbody>
<tr>
<td>Rice</td>
<td>1, 1.23</td>
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<tr>
<td>Wheat</td>
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</tr>
<tr>
<td>Feed grains</td>
<td>3, 3</td>
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<tr>
<td>PVegetables and fruits</td>
<td>4</td>
</tr>
<tr>
<td>Oilseeds</td>
<td>5</td>
</tr>
<tr>
<td>Sugar</td>
<td>6, 6, 24</td>
</tr>
<tr>
<td>Plant based fibers</td>
<td>7</td>
</tr>
<tr>
<td>Livestock &amp; meat</td>
<td>8, 9, 10, 12, 19, 20</td>
</tr>
<tr>
<td>Dairy</td>
<td>9, 11, 22</td>
</tr>
<tr>
<td>Other food</td>
<td>10, 8, 21, 25</td>
</tr>
<tr>
<td>Beverages &amp; tobacco</td>
<td>11</td>
</tr>
<tr>
<td>Extractive industries</td>
<td>12, 13, 14, 15, 16, 12, 18</td>
</tr>
<tr>
<td>Textiles</td>
<td>13, 27</td>
</tr>
<tr>
<td>Apparel</td>
<td>14, 28</td>
</tr>
<tr>
<td>Light manufacturing</td>
<td>15</td>
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<tr>
<td>Petrochemical industry</td>
<td>16, 32, 16, 34</td>
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<tr>
<td>Metals</td>
<td>17, 35, 36, 37</td>
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<tr>
<td>Autos</td>
<td>18, 38</td>
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<tr>
<td>Electronics</td>
<td>19, 40</td>
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<tr>
<td>Other manufactures</td>
<td>20, 30, 31, 39, 41, 42</td>
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<tr>
<td>Trade and transport</td>
<td>21, 47, 48, 49, 50</td>
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<tr>
<td>Construction</td>
<td>22, 46</td>
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<tr>
<td>Communication</td>
<td>23, 51</td>
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<tr>
<td>Commercial services</td>
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<tr>
<td>Other services</td>
<td>25, 43, 44, 45, 55, 56,</td>
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**Table A2: Sectoral classification in GTAP model and their concordance in China’s rural/urban household surveys**

<table>
<thead>
<tr>
<th>Sectors of GTAP 57</th>
<th>Urban survey code</th>
<th>Rural survey code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Paddy rice</td>
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<td></td>
</tr>
<tr>
<td>2 Wheat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Cereal grains nec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Vegetables\ fruit\ nuts</td>
<td>x558, x754, x978, x1026, x590</td>
<td>x165, x945, x163, x167, x630, x668, x674</td>
</tr>
<tr>
<td>5 Oil seeds</td>
<td>x586</td>
<td></td>
</tr>
<tr>
<td>6 Sugar cane\ sugar beet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Plant-based fibers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Crops nec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Cattle\sheepgoatshorses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Animal products nec</td>
<td>x666, x670, x690, x694</td>
<td>x181, x213, x191, x399, x189, x200, x640, x644, x931, x933</td>
</tr>
<tr>
<td>11 Raw milk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Wool\silk-worm cocoons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 Fishing</td>
<td>x706</td>
<td></td>
</tr>
<tr>
<td>14 Coal</td>
<td>x1480</td>
<td></td>
</tr>
<tr>
<td>15 Oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 Gas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17 Minerals nec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 Meat\cattle\sheepgoats\horse</td>
<td>x650, x654</td>
<td>x196, x198, x636, x638</td>
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<tr>
<td>19 Meat products nec</td>
<td>x646 x658 x662 x674 x678</td>
<td>x194, x634, x642</td>
</tr>
<tr>
<td>20 Vegetable oils and fats</td>
<td>x606</td>
<td>x626, x628</td>
</tr>
<tr>
<td>21 Dairy products</td>
<td>x1050</td>
<td></td>
</tr>
<tr>
<td>22 Processed rice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23 Sugar</td>
<td>x902</td>
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<tr>
<td>24 Food products nec</td>
<td>x522, x526, x530, x534, x538, x546, x550, x698, x866, x886, x894, x594, x598, x1042, x1074</td>
<td>x632, x646, x649, x528, x529, x656, x658, x680, x538, x53</td>
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<tr>
<td>26 Beverages and tobacco products</td>
<td>x922, x938</td>
<td>x660, x662, x682, x533</td>
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<td>27 Textiles</td>
<td>x1158, x1222, x1260, x1266</td>
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<tr>
<td>28 Wearing apparel</td>
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<td>x542, x701, x544, x546</td>
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<td>29 Leather products</td>
<td>x1108, x1132, x1178</td>
<td>x728, x736, x842</td>
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<td>30 Wood products</td>
<td>x1206, x1286</td>
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<td>31 Paper products\publishing</td>
<td>x1436, x1450, x1514</td>
<td>x596, x597</td>
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<td>32 Petroleum\ coal products</td>
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<td>x907, x909</td>
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<tr>
<td>Sectors of GTAP 57</td>
<td>Urban survey code</td>
<td>Rural survey code</td>
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<td>------------------</td>
<td>------------------</td>
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<tr>
<td>33 Chemical rubber plastic prods</td>
<td>1184, 1224, 1308, 1310, 1522, 1280, 1282, 1284</td>
<td>738, 744, 565, 566, 567, 572, 573, 598, 607, 609, 899, 903, 905</td>
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<tr>
<td>34 Mineral products nec</td>
<td>1466</td>
<td>549, 831, 608</td>
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<td>35 Ferrous metals</td>
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<td>786</td>
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<td>36 Metals nec</td>
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<td>37 Metal products</td>
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<td>882, 913, 915, 917</td>
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<td>38 Motor vehicles and parts</td>
<td>1342, 1346</td>
<td>868, 592, 929</td>
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<td>39 Transport equipment nec</td>
<td>1364, 1406, 1408, 1410, 1412, 1414, 1416, 1418, 1420, 1254, 1512</td>
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<td>44 Gas manufacture/ distribution</td>
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<td>45 Water</td>
<td>1350, 1528</td>
<td>586, 587, 590</td>
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<td>46 Construction</td>
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<td>589</td>
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<td>47 Trade</td>
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<td>48 Transport nec</td>
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<td>50 Air transport</td>
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<td>52 Financial services nec</td>
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<td>53 Insurance</td>
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<td>54 Business services nec</td>
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<td>577, 578, 579, 580, 581, 600, 601</td>
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Table A3: Urban survey sector, occupation and education codes

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<th>Sector codes:</th>
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<tbody>
<tr>
<td>1: Agriculture, forestry, animal husbandry, sideline, fishery</td>
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</tr>
<tr>
<td>2: Mining industry</td>
<td></td>
</tr>
<tr>
<td>3: Manufacturing</td>
<td></td>
</tr>
<tr>
<td>4: Construction</td>
<td></td>
</tr>
<tr>
<td>5: Traffic, transportation, post and telecommunications</td>
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</tr>
<tr>
<td>6: Commerce, catering trade, material supply industry</td>
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</tr>
<tr>
<td>7: Housing and public utility management, resident service</td>
<td></td>
</tr>
<tr>
<td>8: Sanitation, sports, social welfare</td>
<td></td>
</tr>
<tr>
<td>9: Culture, arts, and education</td>
<td></td>
</tr>
<tr>
<td>10: Science, research, and technology services</td>
<td></td>
</tr>
<tr>
<td>11: Finance and insurance</td>
<td></td>
</tr>
<tr>
<td>12: State and institutions, party and government mass organization</td>
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</tr>
<tr>
<td>13: Other industry</td>
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</table>

<table>
<thead>
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<th>Occupation codes:</th>
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<tbody>
<tr>
<td>11: Senior engineer</td>
<td></td>
</tr>
<tr>
<td>12: Engineer</td>
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</tr>
<tr>
<td>13: Assistant engineer</td>
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</tr>
<tr>
<td>14: Technician</td>
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</tr>
<tr>
<td>21: Above middle-level cadre</td>
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</tr>
<tr>
<td>22: Section chief cadre</td>
<td></td>
</tr>
<tr>
<td>23: Sub-section chief cadre</td>
<td></td>
</tr>
<tr>
<td>30: Staff-members</td>
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</tr>
<tr>
<td>40: Staff-members in commerce</td>
<td></td>
</tr>
<tr>
<td>50: Staff-members in services</td>
<td></td>
</tr>
<tr>
<td>60: Agriculture, forestry, animal husbandry, sideline, fishery</td>
<td></td>
</tr>
<tr>
<td>70: Staff-members in production and transportation</td>
<td></td>
</tr>
<tr>
<td>80: Workers unclassified</td>
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</table>

<table>
<thead>
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<th>Education levels:</th>
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<tbody>
<tr>
<td>1: University</td>
<td></td>
</tr>
<tr>
<td>2: College</td>
<td></td>
</tr>
<tr>
<td>3: Special or technical school</td>
<td></td>
</tr>
<tr>
<td>4: Senior high school</td>
<td></td>
</tr>
<tr>
<td>5: Junior high school</td>
<td></td>
</tr>
<tr>
<td>6: Primary school</td>
<td></td>
</tr>
<tr>
<td>7: Other</td>
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Table A4: Ranking of provinces (from the poorest to the richest)

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<th>Prov. code</th>
<th>rank by Prov. code</th>
<th>Prov. Inc</th>
<th>rank by rural Inc.</th>
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<td>Gansu</td>
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<td>65</td>
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<td>Qinghai</td>
<td>63</td>
<td>Yunnan</td>
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<td>Shaanxi</td>
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<td>Qinghai</td>
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<td>Chongqing</td>
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Figure 1a: Poverty incidence curves: rural

Figure 1b: Poverty incidence curves: urban
Figure 2a: Mean gains by provinces; absolute gain in Yuan per capita

Figure 2b: Mean gains by provinces; proportionate gains in %
Figure 2c: Mean gains by provinces; percentage of gainers by provinces

Figure 3a: Mean gains in Yuan by income percentile

(Assuming urban price is 15% higher)
Figure 3b: Mean percentage gain by income percentile

Figure 3c: Percentage of gainers by income percentile