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

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Abstract

Chen and Ravallion 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. 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. The authors find negligible impacts on inequality and poverty in the aggregate. However, diverse impacts emerge across household types and regions associated with heterogeneity in consumption behavior and income sources, with possible implications for compensatory policy responses.

This paper—a product of the Poverty Team, Development Research Group—is part of a larger effort in the group to assess the household welfare impacts of economywide policy changes. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Patricia Sader, room MC3-556, telephone 202-473-3902, fax 202-522-1151, email address psader@worldbank.org. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at schen@worldbank.org or mravallion@worldbank.org. May 2003. (42 pages)

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

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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.

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[2] For example see Bourguignon and Morisson (1990), Edwards (1997), Li et al., (1998), Lundberg and Squire (1999), Barro (2000), Dollar and Kray (2002) and Milanovic (2002).

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.[3] 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

[3] Jalan and Ravallion (1998) report evidence of such churning using panel data for rural China. Baulch and Hoddinott (2000) review evidence for a number of countries.

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.[4] 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

[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).[5] 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 $u_i(q_i^d, L_i)$ where q_i^d 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_i^d 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:

$$v_i[p_i^d, w_i, \pi_i] = \max_{(q_i^d, L_i)} [u_i(q_i^d, L_i) \Big| p_i^d q_i^d = w_i L_i + \pi_i] \tag{1}$$

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

$$\pi_i(p_i^s, p_i^d, w_i) = \max_{(z_i, L_i^o)} [p_i^s q_i^s - p_i^d z_i - w_i L_i^o \Big| q_i^s = f_i(z_i, L_i^o)] \tag{2}$$

where p_i^d is the vector of supply prices, q_i^s is the vector of quantities supplied, L_i^o is the labor input to the own production activities, f_i is the household-specific production function (embodying 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.[6] 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:

$$g_i \equiv \frac{du_i}{v_m} = \sum_{j=1}^{m} [p_{ij}^s q_{ij}^s \frac{dp_{ij}^s}{p_{ij}^s} - p_{ij}^d (q_{ij}^d + z_{ij}) \frac{dp_{ij}^d}{p_{ij}^d}] + \sum_{k=1}^{n} (w_k L_{ik}^s \frac{dw_k}{w_k}) \tag{3}$$

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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_{ri} is the marginal utility of income for household i (the multiplier on the budget constraint in equation 1) and $L_{ik}^{s} = L_{ik} - L_{ik}^{o}$ 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 $w_k L_{ik}^{s}$ 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.[7] 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.[8] 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

[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.[9] 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

[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, $p_3^s q_{i3}^s$ relates to the cash income from the productions of corn, millet, potato etc.,; $p_3^d q_{i3}^d$ 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.) $p_3^d z_{i3}$ 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:

$$v_i(p_i^d, w_i, \pi_i) = v(p_i^d, w_i, \pi_i, x_{1i}) = \max[u(q_i^d, L_i, x_{1i}) \mid p_i^d q_i^d - w_i L_i = \pi_i] \qquad (4)$$

where

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

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:

$$g_i = g(p_i^d, p_i^s, w_i, x_{1i}, x_{2i}) =$$
$$\sum_{j=1}^{m}[p_{ij}^s q^s(p_i^d, p_i^s, w_i, x_{2i})\frac{dp_{ij}^s}{p_{ij}^s} - p_{ij}^d[q^d(p_i^d, w_i, \pi_i, x_{1i}) + z_{ij}(p_i^d, p_i^s, w_i, x_{2i})]\frac{dp_{ij}^d}{p_{ij}^d}] \quad (6)$$
$$+ \sum_{k=1}^{n} w_k[L_{ik}(p_i^d, w_i, \pi_i, x_{1i}) - L_{ik}^o(p_i^d, p_i^s, w_i, x_{2i})]\frac{dw_k}{w_k})$$

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 π_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 $w_i = w(p_i^d, p_i^s, x_{1i}, x_{2i})$ 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:

$$g_i = \beta_1 x_{1i} + \beta_2 x_{2i} + \sum_k \gamma_k D_{ki} + \varepsilon_i \qquad (7)$$

where $D_{ki} = 1$ if household i lives in county k and $D_{ki} = 0$ otherwise and ε_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.

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

	Wholesale Prices	Consumer Prices	Rural		Urban	
			Net revenue	Mean welfare change	Net revenue	Mean welfare change
	% change	% change	Yuan	Yuan	Yuan	Yuan
Expenditures						
Rice	0.5	1.5	73.66	0.15	-109.33	-1.64
Wheat	-1.7	-1.5	40.86	-0.74	0.00	0.00
Feedgrains	2.6	10.7	117.04	2.15	0.00	0.00
Vegetables & fruits	0.5	1.5	123.41	0.13	-378.69	-5.68
Oilseeds	-0.6	-0.8	37.05	-0.24	-1.04	0.01
Sugar	0.7	1.4	13.74	0.05	-174.06	-2.44
Plant based fibers	-3.6	-1.9	36.84	-1.34	0.00	0.00
Livestock & meat	2.0	3.1	194.62	2.59	-500.65	-15.52
Dairy	1.5	2.5	2.50	0.02	0.00	0.00
Other food	1.2	3.1	-81.60	-3.39	-343.13	-10.64
Beverages & tobacco	-4.6	-7.2	-72.98	5.25	-197.20	14.20
Extractive industries	-0.2	0.8	17.99	-0.44	-173.03	-1.38
Textiles	-5.0	-8.9	-11.08	0.99	-53.50	4.76
Apparel	-2.7	-7.4	-64.13	4.75	-394.30	29.18
Light manufacturing	-0.3	-2.5	-16.15	0.40	-82.96	2.07
Petrochemical industry	-0.7	-0.1	-325.39	0.33	-398.23	0.40
Metals	-0.7	-0.1	-15.30	0.02	-24.02	0.02
Autos	-17.7	-20.4	-52.27	10.66	-37.76	7.70
Electronics	-1.5	-4.0	-24.27	0.97	-162.69	6.51
Other manufactures	-0.6	-0.3	-264.61	0.79	-431.16	1.29
Trade and transport	0.2	1.3	-18.70	-0.24	-110.53	-1.44
Construction	0.1	1.1	0.00	0.00	-31.11	-0.34
Communication	0.9	1.9	-16.72	-0.32	-152.04	-2.89
Commercial services	0.8	1.8	-61.37	-1.10	-533.33	-9.60
Other services	0.1	1.1	-414.45	-4.56	-680.99	-7.49
Income sources						
Farm unskilled labor	1.7	1.7	313.58	5.22		0.00
Nonfarm unskilled	1.7	1.7	287.19	4.78	1227.51	20.44
Skilled labor	2.0	2.0	360.87	7.09	3391.11	66.64
Land	1.3	1.3	17.08	0.22		0.00
Capital	1.3	1.3	21.14	0.27	126.01	0.77

Table 1b: Predicted price changes from GTAP model 2001-07 and per capita net gain or loss for rural and urban households

	Wholesale Prices	Consumer Prices	Rural		Urban	
			Net revenue	Mean welfare change	Net revenue	Mean welfare change
	% change	% change	Yuan	Yuan	Yuan	Yuan
Expenditures						
Rice	-1.4	0.7	73.66	-1.39	-109.33	-0.75
Wheat	-1.5	0.7	40.86	-0.92	0.00	0.00
Feedgrains	-3.7	2.1	117.04	-4.90	0.00	0.00
Vegetables & fruits	-2.6	-0.6	123.41	-4.02	-378.69	2.24
Oilseeds	-5.7	-5.9	37.05	-2.10	-1.04	0.06
Sugar	-2.8	-3.5	13.74	-0.34	-174.06	6.01
Plant based fibers	1.6	4.1	36.84	0.56	0.00	0.00
Livestock & meat	-1.5	0.7	194.62	-5.21	-500.65	-3.40
Dairy	-2.4	-0.5	2.50	-0.09	0.00	0.00
Other food	-3.1	-2.7	-81.60	2.04	-343.13	9.32
Beverages & tobacco	-5.6	-7.7	-72.98	5.62	-197.20	15.09
Extractive industries	-0.4	1.7	17.99	-0.86	-173.03	-2.92
Textiles	-0.2	-1.5	-11.08	0.17	-53.50	0.82
Apparel	2.6	0.8	-64.13	-0.51	-394.30	-2.98
Light manufacturing	-0.6	0.5	-16.15	-0.08	-82.96	-0.43
Petrochemical industry	-1.1	0.8	-325.39	-2.60	-398.23	-3.19
Metals	-0.6	1.3	-15.30	-0.20	-24.02	-0.31
Autos	-3.8	-4.0	-52.27	2.09	-37.76	1.52
Electronics	-1.2	-1.4	-24.27	0.34	-162.69	2.20
Other manufactures	-0.8	0.8	-264.61	-2.12	-431.16	-3.46
Trade and transport	-0.4	1.7	-18.70	-0.32	-110.53	-1.85
Construction	-0.4	1.7	0.00	0.00	-31.11	-0.52
Communication	-0.4	1.7	-16.72	-0.28	-152.04	-2.54
Commercial services	-1.1	0.9	-61.37	-0.55	-533.33	-4.72
Other services	-0.7	1.3	-414.45	-5.39	-680.99	-8.76
Income sources						
Farm unskilled labor	-0.3	-0.3	313.58	-0.85		
Nonfarm unskilled	1.0	1.0	287.19	2.96	1227.51	12.64
Skilled labor	0.4	0.4	360.87	1.55	3391.11	14.58
Land	-4.7	-4.7	17.08	-0.80		
Capital	0.6	0.6	21.14	0.13	126.01	0.80

Table 2: Summary statistics on aggregate welfare impacts

	Rural	Urban	National
1. Mean gains (Yuan/capita)			
1995-2001	34.47	94.94	55.49 (1.54%)*
2001-07	-18.07	29.45	-1.54 (-0.04%)*
2. Inequality impacts (Gini index as %)			
Baseline (1999)	33.95	29.72	39.31
Simulated: Less gains 1995-2001	33.90	29.68	39.27
Simulated: Plus gains 2001-07	34.06	29.65	39.53
3. Poverty impacts (headcount index, %)			
Official poverty line			
Baseline (1999)	4.38	0.08	2.92
Simulated: Less gains 1995-2001	4.56	0.08	3.04
Simulated: Plus gains 2001-07	4.57	0.07	3.04
$1/day (1993 PPP)			
Baseline (1999)	10.51	0.29	7.04
Simulated: Less gains 1995-2001	10.88	0.28	7.28
Simulated: Plus gains 2001-07	10.81	0.28	7.23
$2/day (1993 PPP)			
Baseline (1999)	45.18	4.07	31.20
Simulated: Less gains 1995-2001	46.10	4.27	31.88
Simulated: Plus gains 2001-07	45.83	3.97	31.60

Note: * gives % of mean income

Table 3a: Gain or loss by province; rural areas

	Sampled h'holds	Number of gainers	Original income	Post-WTO income	Gain or loss	Change (%)	% losers
Beijing	750	381	4221.05	4210.08	-10.96	-0.26	49.20
Tianjin	595	219	3401.71	3380.48	-21.22	-0.62	63.19
Hebei	4200	1310	2441.50	2426.82	-14.68	-0.60	68.81
Shanxi	2100	926	1772.62	1765.13	-7.49	-0.42	55.90
Inner Mongolia	2198	206	2055.49	2011.26	-44.22	-2.15	90.63
Liaoning	1886	353	2501.98	2469.64	-32.34	-1.29	81.28
Jilin	1598	132	2260.12	2210.46	-49.66	-2.20	91.74
Heilongjiang	1997	115	2166.59	2114.18	-52.41	-2.42	94.24
Shanghai	600	416	5409.11	5428.79	19.68	0.36	30.67
Jiangsu	3400	1209	3495.20	3486.78	-8.42	-0.24	64.44
Zhejiang	2693	1148	3946.44	3934.92	-11.52	-0.29	57.37
Anhui	3095	676	1900.76	1885.79	-14.97	-0.79	78.16
Fujian	1750	469	3091.39	3071.40	-19.99	-0.65	73.20
Jiangxi	2450	553	2129.45	2117.26	-12.19	-0.57	77.43
Shandong	4200	822	2520.76	2494.89	-25.87	-1.03	80.43
Henan	4200	828	1948.36	1931.70	-16.66	-0.86	80.29
Hubei	3188	755	2212.71	2200.04	-12.68	-0.57	76.32
Hunan	3700	1181	2102.98	2095.39	-7.60	-0.36	68.08
Guangdong	2560	514	3628.95	3599.61	-29.34	-0.81	79.92
Guangxi	2310	309	2048.33	2025.75	-22.58	-1.10	86.62
Hainan	718	28	2086.40	2057.85	-28.55	-1.37	96.10
Chongqing	1500	404	1736.63	1730.20	-6.43	-0.37	73.07
Sichuan	3998	879	1843.23	1830.92	-12.31	-0.67	78.01
Guizhou	2240	417	1363.07	1354.03	-9.04	-0.66	81.38
Yunnan	2397	399	1438.34	1421.34	-17.00	-1.18	83.35
Tibet	480	143	1309.46	1307.41	-2.05	-0.16	70.21
Shaanxi	2217	446	1456.48	1442.09	-14.39	-0.99	79.88
Gansu	1800	479	1357.28	1350.34	-6.95	-0.51	73.39
Qinghai	600	135	1466.67	1452.61	-14.06	-0.96	77.50
Ningxia	600	108	1754.15	1729.05	-25.11	-1.43	82.00
Xinjiang	1495	312	1471.11	1447.57	-23.55	-1.60	79.13
Rural China	67515	16272	2257.15	2239.08	-18.07	-0.80	75.90

Table 3b: Gain or loss by province; urban areas

	Sampled h'holds	Number of gainers	Original income	Post-WTO income	Gain or loss	Change (%)	% losers
Beijing	500	430	9388.88	9431.72	42.84	0.46	14.00
Tianjin	500	451	7323.57	7358.47	34.91	0.48	9.80
Hebei	650	591	5673.46	5702.35	28.89	0.51	9.08
Shanxi	650	598	4519.20	4549.94	30.74	0.68	8.00
Inner Mongolia	550	495	4491.87	4516.19	24.32	0.54	10.00
Liaoning	1000	916	5257.42	5285.65	28.23	0.54	8.40
Jilin	700	610	4630.13	4650.46	20.33	0.44	12.86
Heilongjiang	1000	887	4798.92	4820.50	21.58	0.45	11.30
Shanghai	500	458	10927.18	10984.16	56.98	0.52	8.40
Jiangsu	800	723	6933.07	6968.78	35.71	0.51	9.63
Zhejiang	550	498	9044.40	9098.28	53.87	0.60	9.45
Anhui	500	458	5159.46	5190.37	30.91	0.60	8.40
Fujian	550	516	7521.52	7569.70	48.18	0.64	6.18
Jiangxi	550	498	4762.78	4783.38	20.60	0.43	9.45
Shandong	650	602	5689.90	5720.69	30.78	0.54	7.38
Henan	600	565	4689.43	4717.89	28.46	0.61	5.83
Hubei	750	619	5743.18	5765.29	22.11	0.38	17.47
Hunan	700	612	5727.42	5750.43	23.00	0.40	12.57
Guangdong	600	490	10871.06	10903.85	32.79	0.30	18.33
Guangxi	600	496	6011.10	6033.40	22.30	0.37	17.33
Hainan	200	172	5766.33	5787.64	21.31	0.37	14.00
Chongqing	300	239	5910.18	5931.90	21.72	0.37	20.33
Sichuan	800	691	5610.29	5634.60	24.30	0.43	13.63
Guizhou	450	383	5324.43	5347.71	23.27	0.44	14.89
Yunnan	650	566	5939.69	5973.23	33.54	0.56	12.92
Tibet				n.a.			
Shaanxi	500	427	4768.99	4788.25	19.26	0.40	14.60
Gansu	400	372	4610.86	4641.27	30.41	0.66	7.00
Qinghai	250	240	3759.53	3788.65	29.12	0.77	4.00
Ningxia	200	177	4472.43	4493.27	20.84	0.47	11.50
Xinjiang	250	214	5277.25	5295.94	18.69	0.35	14.40
Urban China	16900	14994	6046.13	6075.60	29.45	0.49	11.28

Table 4a: Regressions for level (Yuam) of gain in rural areas of three provinces

	Liaoning		Guangdong		Sichuan	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Log of household size	37.642	6.42	28.822	2.64	4.958	2.16
Age of household head	-2.425	-3.11	-1.783	-2.60	-0.548	-1.51
Squared age	0.026	3.36	0.017	2.66	0.005	1.30
Agriculture household	-10.942	-3.31	-42.850	-6.45	-37.723	-6.54
# of employee/h'hold size	12.665	4.10	-6.932	-0.29	12.652	3.02
# of TVE workers/hh size	10.768	3.13	29.466	3.06	15.327	4.26
# of migrate workers/hh size	5.399	1.73	7.798	2.35	7.067	3.79
Area of cultivated land	-0.027	-5.73	-0.002	-1.00	-0.001	-0.28
Area of hilly land	0.000	-0.05	-0.001	-0.87	0.002	1.94
Area of fishpond land	-0.001	-0.94	-0.070	-2.85	0.000	0.04
Highest education level is						
... illiterate or semi-illiterate	7.926	1.04	19.016	1.25	8.387	0.92
... primary school	0.071	0.01	-2.148	-0.13	9.694	1.06
... middle school	-0.755	-0.11	-4.261	-0.26	7.669	0.84
... high school	2.125	0.31	2.806	0.18	9.675	1.03
... technical school	-3.096	-0.44	-36.482	-1.09	4.270	0.38
... college (default)						
Ratio of labor force	0.576	0.08	2.877	0.15	-4.995	-1.16
Ratio of children under 6	46.999	2.71	8.109	0.35	-2.291	-0.45
Ratio of children age 6-11	1.414	0.11	2.247	0.10	-9.011	-1.50
Ratio of children age 12-14	-0.155	-0.01	-24.489	-1.20	-9.606	-1.51
Ratio of children age 15-17	-2.592	-0.22	-23.390	-1.02	-5.485	-0.73
Constant	-17.851	-0.82	-17.742	-0.65	-17.220	-1.43
R-square	0.278		0.116		0.116	

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

	Liaoning		Guangdong		Sichuan	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Log of household size	0.768	2.46	0.022	0.20	0.030	0.40
Age of household head	-0.108	-2.17	-0.007	-0.34	-0.004	-0.31
Squared age	0.001	2.19	0.000	0.40	0.000	-0.02
Agriculture household	-0.896	-2.98	-1.365	-14.85	-1.420	-7.58
# of employee/hh size	0.630	2.76	0.271	2.57	0.444	3.61
# of TVE workers/hh size	0.669	4.27	0.585	4.47	0.548	6.11
# of migrate workers/hh size	0.655	3.59	0.187	3.59	0.346	7.08
Area of cultivated land	0.000	-1.77	0.000	-0.73	0.000	-1.61
Area of hilly land	0.000	-0.48	0.000	-0.35	0.000	2.20
Area of fishpond land	0.000	-0.17	-0.001	-2.23	0.000	0.55
Highest education level is						
... illiterate or semi-illiterate	1.393	2.18	0.507	1.26	-0.013	-0.05
... primary school	-0.634	-2.01	-0.154	-0.90	0.069	0.30
... middle school	-0.891	-3.08	-0.023	-0.14	-0.011	-0.05
... high school	-0.660	-2.42	0.010	0.06	0.006	0.02
... technical school	-0.573	-1.87	-0.229	-1.18	0.038	0.14
... college (default)						
Ratio of labor force	0.456	0.85	0.323	1.81	-0.099	-0.71
Ratio of children under 6	3.730	3.61	0.461	1.49	-0.169	-0.78
Ratio of children age 6-11	1.557	1.41	0.173	0.72	-0.275	-1.48
Ratio of children age 12-14	1.625	1.54	-0.477	-1.60	-0.343	-1.85
Ratio of children age 15-17	1.325	1.80	-0.289	-0.91	-0.192	-0.88
Constant	0.788	0.69	-0.709	-1.39	-0.584	-1.68
R-square	0.108		0.217		0.171	

Table 5a: Regressions for level (Yuan) of gain in urban areas of three provinces

	Liaoning		Guangdong		Sichuan	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Log of household size	-5.627	-1.81	5.289	0.27	-19.441	-4.09
Single head h'hold	-1.366	-0.4	-37.216	-2.06	-17.369	-3.61
Age of household head	0.531	0.92	5.266	2.43	1.542	2.34
Squared age	-0.001	-0.24	-0.040	-1.8	-0.015	-2.22
Highest education level (default is university)						
... primary school or lower	13.240	2.95	50.434	2.4	23.079	3.11
... middle school	19.104	5.99	56.659	3.58	26.096	4.34
... high school	5.123	1.62	12.053	0.95	12.717	2.39
... technical school	11.086	3.23	11.075	0.88	9.552	1.62
... college	3.974	1.26	3.447	0.3	11.013	2.12
Sector (default is govt.)						
... agriculture	-16.310	-1.22	-25.590	-2.23	17.293	1.76
... mining	-14.586	-3.24	19.351	1.13	-3.851	-0.53
...manufacturing	-9.231	-2.59	17.773	1.28	-4.634	-1.2
...utility	-9.387	-1.63	-10.816	-0.42	1.516	0.13
...construction	-6.394	-1.18	8.622	0.63	-4.409	-0.92
...geological prospecting & water conservancy	-27.422	-2.62	20.089	0.92	-16.585	-0.83
...trans. & telecom.	6.368	1.52	16.525	1.24	1.644	0.25
...wholesale & retail etc.	-3.184	-0.61	5.664	0.45	-1.983	-0.4
...banking & finance	-5.278	-0.55	3.888	0.3	9.491	0.85
...real estate	-11.708	-1.71	46.192	1.35	7.670	0.37
...social services	-5.542	-1.02	-4.186	-0.33	0.504	0.1
...health care etc.	-9.260	-1.93	0.683	0.04	-1.049	-0.17
...education etc.	-7.279	-1.64	7.649	0.46	-5.219	-0.87
...scientific research	-20.982	-4.06	17.882	1.14	-7.929	-0.59
...others	-7.784	-1.42	-24.851	-0.75	-7.012	-0.73
Type of employer (default is state owned)						
...collective-owned	-1.927	-0.76	11.882	0.54	-5.946	-2.09
...foreign company	-3.138	-0.72	-10.988	-1.22	2.038	0.31
...private-business owner	4.278	0.6	9.448	0.64	10.582	2.08
...private-owned	-9.587	-1.41	-14.823	-0.99	-4.601	-0.57
...retirees re-employed	-13.333	-2.45	-35.591	-1.82	-6.752	-0.99
...retirees	-15.569	-3.66	-49.442	-1.91	-12.218	-1.95
...others	-10.350	-1.36	-6.568	-0.34	-16.796	-2.06
Occupation (default is retiree)						
Engineer & technician	10.244	1.66	3.479	0.12	10.179	1.49
Officers	12.747	2.07	17.701	0.64	10.564	1.53
staff in commerce	11.742	2.08	18.553	0.65	12.734	1.92
staff in services	19.940	2.54	3.380	0.11	4.057	0.5
worker in manufactory etc.	17.484	2.02	13.151	0.47	13.810	1.86
worker in trans. & telecom. etc.	21.469	3.59	9.637	0.34	16.117	2.35
Other	15.318	2.05	9.810	0.27	-6.141	-0.77
Constant	-10.744	-0.77	-164.442	-2.43	-17.611	-1.1
R-square	0.265		0.131		0.181	

Table 5b: Regressions for percentage gains in urban areas of three provinces

	Liaoning		Guangdong		Sichuan	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Log of household size	0.175	3.54	-0.038	-0.4	0.036	0.46
Single head h'hold	-0.022	-0.36	-0.221	-2.21	-0.259	-3.07
Age of household head	0.000	-0.01	0.033	2.55	0.017	1.53
Squared age	0.000	0.1	0.000	-2.12	0.000	-1.46
Highest education level (default is university)						
... primary school or lower	0.524	6.43	0.389	3.7	0.509	5.15
... middle school	0.539	10.41	0.583	7.25	0.591	8.27
... high school	0.180	3.56	0.095	1.46	0.262	3.83
... technical school	0.214	4.04	0.076	1.22	0.120	1.79
... college	0.054	1.04	0.015	0.25	0.125	2.24
Sector (default is govt.)						
... agriculture	-0.079	-0.32	0.166	2.2	0.338	2 64
... mining	0.183	1.11	0.346	3.38	-0.129	-1.01
...manufacturing	-0.015	-0.27	0.114	1.41	-0.021	-0.34
...utility	-0.040	-0.36	-0.144	-1.18	-0.134	-0 84
...construction	0.095	0.91	0.109	1.19	0.036	0.51
...geological prospecting & water conservancy	-0.407	-3.06	0.178	1.03	-0.228	-0.53
...trans. & telecom.	0.206	2.93	0.060	0.79	-0.036	-0.4
...wholesale & retail etc.	0.060	0.78	0.081	0.99	-0.015	-0.18
...banking & finance	-0.088	-0.47	0.049	0.53	0.013	0.12
...real estate	-0.108	-0.91	0.222	1.16	0.106	0.29
...social services	-0.090	-1.09	0.065	0.69	0.148	1.37
...health care etc.	-0.088	-1.1	0.007	0.06	-0.124	-1.49
...education etc.	-0.057	-0.75	0.044	0.44	-0.031	-0.39
...scientific research	-0.454	-4.09	0.126	1.11	-0.082	-0.73
...others	0.012	0.14	0.034	0.25	-0.121	-0.55
Type of employer (default is state owned)						
...collective-owned	0.053	1.16	0.008	0.08	0.137	1.73
...foreign company	-0.046	-0.54	-0.122	-2.3	-0.193	-2.08
...private-business owner	-0.069	-0.59	-0.051	-0.39	0.317	2.46
...private-owned	-0.182	-1.65	-0.231	-1.96	-0.037	-0.22
...retirees re-employed	-0.302	-3.39	-0.242	-1.41	-0.177	-1.32
...retirees	-0.341	-4.2	-0.452	-2.37	-0.359	-3.42
...others	-0.124	-1.13	-0.187	-1.24	-0.338	-1.2
Occupation (default is retiree)						
Engineer & technician	-0.015	-0.14	-0.141	-0.69	-0.036	-0.29
Officers	-0.044	-0.43	-0.063	-0.31	-0.045	-0.36
Staff in commerce	0.012	0.12	-0.036	-0.17	0.029	0.24
Staff in services	0.437	3.08	0.019	0.09	-0.011	-0.08
worker in manufactory etc.	0.118	0.82	0.025	0.12	0.091	0.56
worker in trans. & telecom. etc.	0.209	2.02	-0.018	-0.09	0.130	1.03
Other	0.171	1.33	-0.069	-0.27	-0.636	-4.2
Constant	0.172	0.7	-0.623	-1.68	-0.197	-0.71
R-square	0.401		0.290		0.359	

Table 6: Average loss for agriculture households in selected counties

	NBS county identifier	Loss		Provincial mean	
		in Yuan	in %	in Yuan	in %
Liaoning	210181	-73.72	-3.07	-32.34	-1.29
	210212	-145.40	-2.99		
	210381	-172.01	-5.57		
	210921	-57.70	-5.21		
	211321	-45.58	-3.78		
	211322	-53.60	-3.23		
Guangdong	440111	-107.31	-2.74	-29.34	-0.81
	440126	-183.63	-2.64		
	440223	-102.33	-3.53		
	440523	-148.90	-2.55		
	440620	-227.23	-3.11		
	440621	-109.59	-2.64		
	441425	-316.49	-5.34		
Sichuan	510121	-130.46	-2.86	-12.31	-0.67
	510125	-63.19	-3.81		
	512425	-138.34	-5.71		
	512610	-52.23	-3.11		
	512825	-40.44	-2.80		
	513021	-93.02	-4.07		

Note: Agriculture household means that more than 75 % of income is from agriculture.

Appendix: Table A1: Sectoral classification used in China GTAP model

	China GTAP code	GTAP57 code
Rice	1	1,23
Wheat	2	2
Feed grains	3	3
PVegetables and fruits	4	4
Oilseeds	5	5
Sugar	6	6,24
Plant based fibers	7	7
Livestock & meat	8	9,10,12,19,20
Dairy	9	11,22
Other food	10	8,21,25
Beverages & tobacco	11	26
Extractive industries	12	13,14,15,16,12,18
Textiles	13	27
Apparel	14	28
Light manufacturing	15	29
Petrochemical industry	16	32,16,34
Metals	17	35,36,37
Autos	18	38
Electronics	19	40
Other manufactures	20	30,31,39,41,42
Trade and transport	21	47,48,49,50
Construction	22	46
Communication	23	51
Commercial services	24	52,53,54,57
Other services	25	43,44,45,55,56,

Table A2: Sectoral classification in GTAP model and their concordance in China's rural/urban household surveys

	Sectors of GTAP 57	Urban survey code	Rural survey code
1	Paddy rice		x149, x942
2	Wheat		x147, x941
3	Cereal grains nec		x151, x943, x944, x145, x518
4	Vegetables\ fruit\ nuts	x558, x754, x978, x1026, x590	x165, x945, x163, x167, x630, x668, x674
5	Oil seeds	x586	x155
6	Sugar cane\sugar beet		x159
7	Plant-based fibers		x153, x157
8	Crops nec		x161, x392, x169, x666, x557, x558, x901
9	Cattle\sheepgoatshorses		x183, x185
10	Animal products nec	x666, x670, x690, x694	x181, x213, x191, x399, x189, x200, x640, x644, x931, x933
11	Raw milk		x209, x207, x676
12	Wool\silk-worm cocoons		x203, x205, x211
13	Forestry		x172, x174, x176, x178, x398
14	Fishing	x706	x215, x648
15	Coal	x1480	x816, x818, x911
16	Oil		x820
17	Gas		
18	Minerals nec		
19	Meat\ cattle\sheepgoats\horse	x650, x654	x196, x198, x636, x638
20	Meat products nec	x646 x658 x662 x674 x678	x194, x634, x642
21	Vegetable oils and fats	x606	x626, x628
22	Dairy products	x1050	x678
23	Processed rice	x514, x518	
24	Sugar	x902	x654
25	Food products nec	x522, x526, x530, x534,x538, x546, x550, x698,x866, x886, x894, x594, x598, x1042, x1074	x632, x646, x649, x528, x529, x656, x658, x680, x538, x53
26	Beverages and tobacco products	x922, x938	x660, x662, x682, x533
27	Textiles	x1158, x1222, x1260, x1266	x543, x568
28	Wearing apparel	x1110, x1112, x1114, x1116, x1118, x1120, x1122, x1124, x1126, x1128, x1134, x1136, x1138, x1140, x1142, x1144, x1146, x1148, x1150, x1152, x1154, x1156, x1180, x1182, x1186, x1188, x1190, x1192, x1194, x1196	x542, x701, x544, x546
29	Leather products	x1108, x1132, x1178	x728, x736, x842
30	Wood products	x1206, x1286	x782, x563, x574
31	Paper products\publishing	x1436, x1450, x1514	x596, xx597
32	Petroleum\ coal products		x907, x909

	Sectors of GTAP 57	Urban survey code	Rural survey code
33	Chemical rubber plastic prods	x1184, x1224, x1308, x1310, x1522, x1280, x1282, x1284	x738, x744, x565, x566, x567,x572, x573, x598, x607, x609, x899, x903, x905
34	Mineral products nec	x1466	x549, x831, x608
35	Ferrous metals		x786
36	Metals nec		
37	Metal products	x1508	x833
38	Motor vehicles and parts	x1340, x1344, x1358	x882, x913, x915, x917
39	Transport equipment nec	x1342, x1346	x868, x592, x929
40	Electronic equipment	x1364, x1406, x1408, x1410, x1412, x1414, x1416, x1418, x1420, x1254, x1512	x595
41	Machinery and equipment nec	x1228, x1262, x1304, x1306, x1422, x1424, x1512, x1520, x1254	x564, x765, x919, x925, x927, x897
42	Manufactures nec	x1226, x1264, x1426, x1428, x1430, x1546, x1516, x1262, x1278, x1524	x575, x576, x921, x923
43	Electricity	x1476	x553
44	Gas manufacture/ distribution	x1482, x1484, x1486, x1488, x1348	x559
45	Water	x1474	
46	Construction	x1470	
47	Trade		
48	Transport nec	x1350, x1528	x586, x587, x590
49	Sea transport	x1530	x589
50	Air transport		x588
51	Communication	x1372, x1374, x1376	x584, x591
52	Financial services nec		
53	Insurance		
54	Business services nec	x1198, x1288, x1360, x1432, x1532, x1534, x1536, x1538, x1098, x1078	x545, x610
55	Recreation and other services	x1448, x1452	x602, x603, x604
56	PubAdmin/Defence/ Health/Educat	x1312, x1314, x1438, x1440, x1442, x1444	x577, x578, x579, x580, x581, x600, x601
57	Dwellings	x1468	x551, x552, x687, x691, x695, x699, x710, x712, x714, x685, x689, x693, x697, x732, x740, x742, x746, x748, x750, x778, x790, x862, x870,x872, x874, x876, x878, x880, x846, x716, x718, x720, x722,x794, x798, x825, x827, x829, x835, x844, x848, x850, x852, x864, x866, x755, x757, x759, x761, x763,x802, x806, x810, x858, x860, x724, x823, x770, x773, x775x770, x773, x775

Table A3: Urban survey sector, occupation and education codes

Sector codes: 1:= Agriculture, forestry, animal husbandry, sideline, fishery 2:= Mining industry 3:= Manufacturing 4:= Construction 5:= Traffic, transportation, post and telecommunications 6:= Commerce, catering trade, material supply industry 7:= Housing and public utility management, resident service 8:= Sanitation, sports, social welfare 9:= Culture, arts, and education 10:= Science, research, and technology services 11:= Finance and insurance 12:= State and institutions, party and government mass organization 13:= Other industry
Occupation codes: 11:= Senior engineer 12:= Engineer 13:= Assistant engineer 14:= Technician 21:= Above middle-level cadre 22:= Section chief cadre 23:= Sub-section chief cadre 30:= Staff-members 40:= Staff-members in commerce 50:= Staff-members in services 60:= Agriculture, forestry, animal husbandry, sideline, fishery 70:= Staff-members in production and transportation 80:= Workers unclassified
Education levels: 1:= University 2:= College 3:= Special or technical school 4:= Senior high school 5:= Junior high school 6:= Primary school 7:= Other

Table A4: Ranking of provinces (from the poorest to the richest)

	Prov. code	rank by prov. Inc		rank by rural inc.
Tibet	54	1	Tibet	1
Gansu	62	2	Gansu	2
Xinjiang	65	3	Guizhou	3
Qinghai	63	4	Yunnan	4
Guizhou	52	5	Shaanxi	5
Shaanxi	61	6	Qinghai	6
Henan	41	7	Xinjiang	7
Anhui	34	8	Chongqing	8
Nıngxia	64	9	Ningxia	9
Shanxi	14	10	Shanxi	10
Yunnan	53	11	Sichuan	11
Inner Mongolia	15	12	Anhui	12
Jiangxi	36	13	Henan	13
Sicuani	51	14	Guangxi	14
Chongqing	50	15	Inner Mongolia	15
Hunan	43	16	Hainan	16
Hebei	13	17	Hunan	17
Guangxi	45	18	Jiangxi	18
Hainan	46	19	Heilongjiang	19
Jilin	22	20	Hubei	20
Hubei	42	21	Jilin	21
Shandong	37	22	Hebei	22
Heilongjiang	23	23	Liaoning	23
Liaoning	21	24	Shandong	24
Jiangsu	32	25	Fujian	25
Fujian	35	26	Tianjin	26
Zhejiang	33	27	Jiangsu	27
Tianjin	12	28	Guangdong	28
Guangdong	44	29	Zhejiang	29
Beijing	11	30	Beijing	30
Shanghai	31	31	Shanghai	31

Figure 1a: Poverty incidence curves: rural

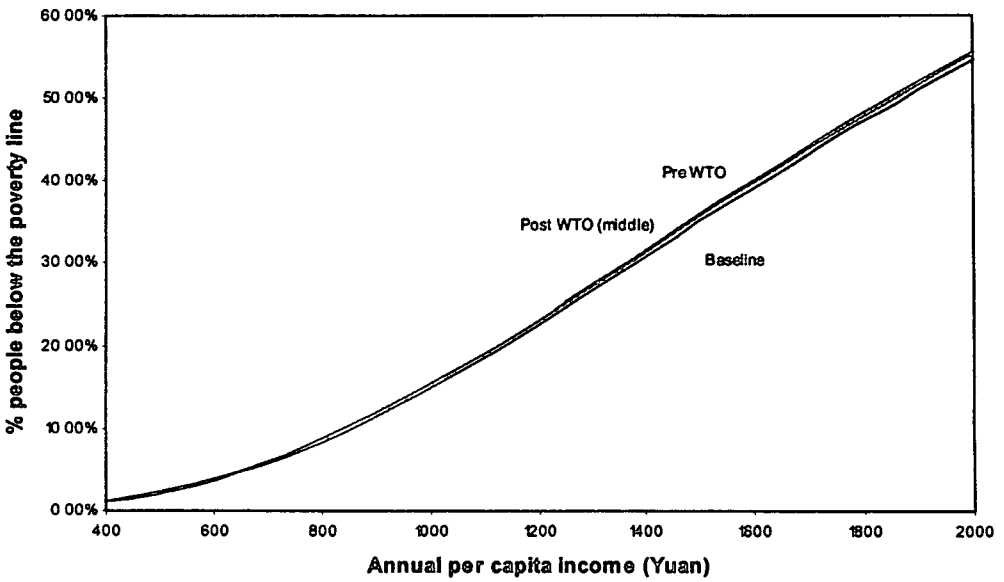

Figure 1b: Poverty incidence curves: urban

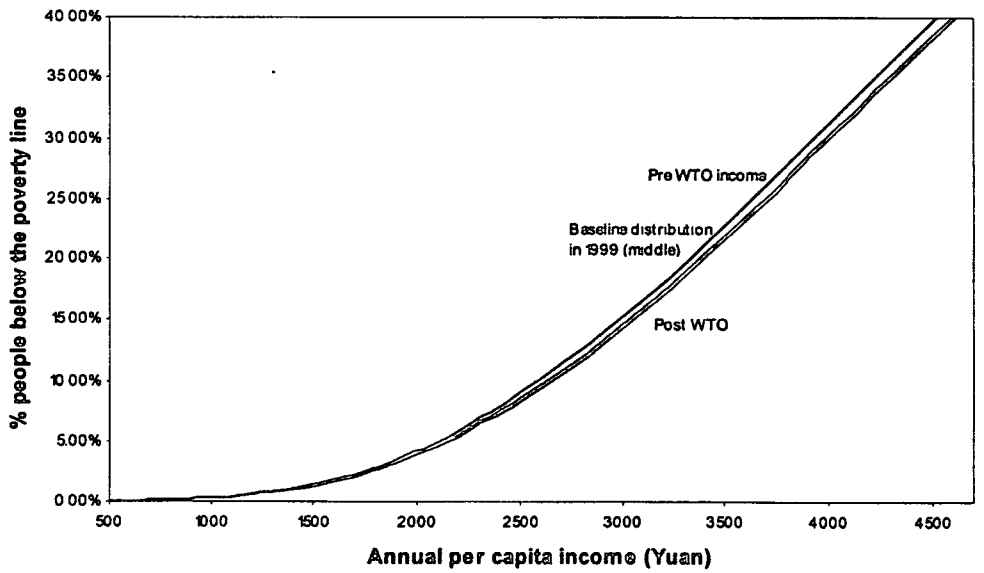

Figure 2a: Mean gains by provinces; absolute gain in Yuan per capita

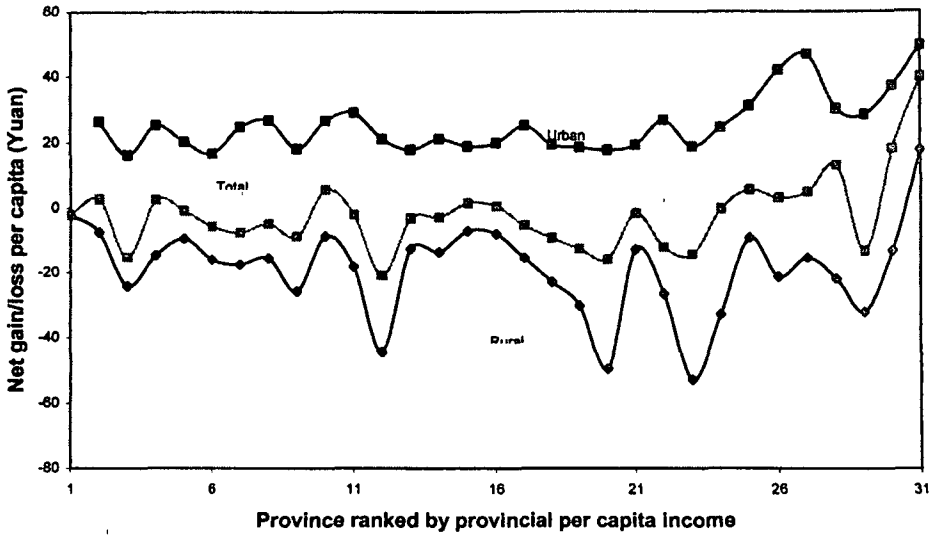

Figure 2b: Mean gains by provinces; proportionate gains in %

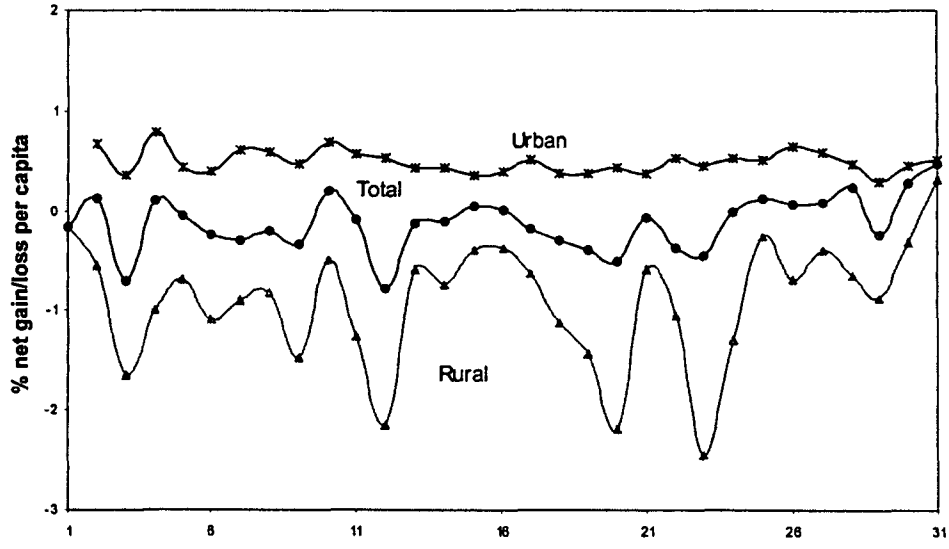

Figure 2c: Mean gains by provinces; percentage of gainers by provinces

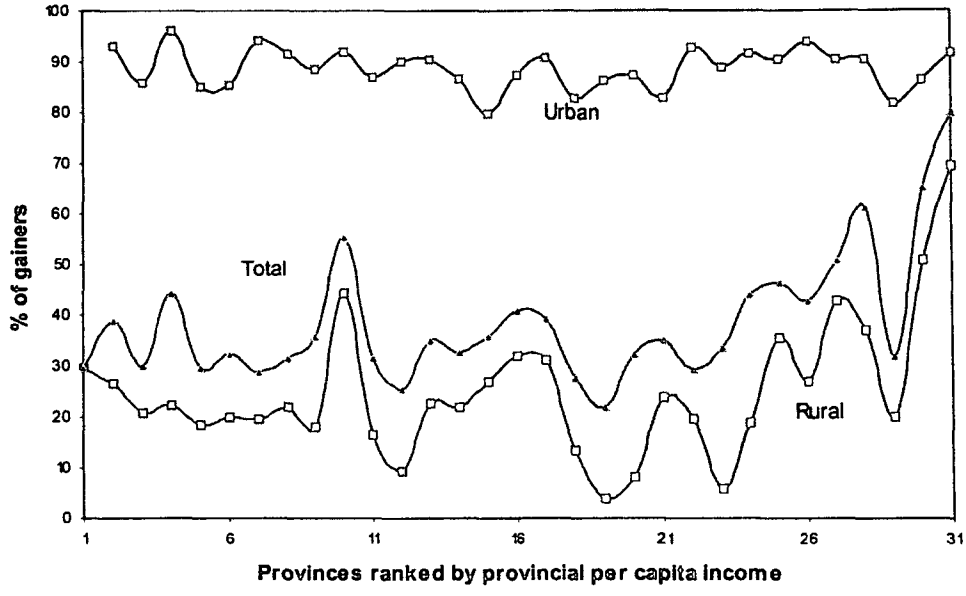

Figure 3a: Mean gains in Yuan by income percentile

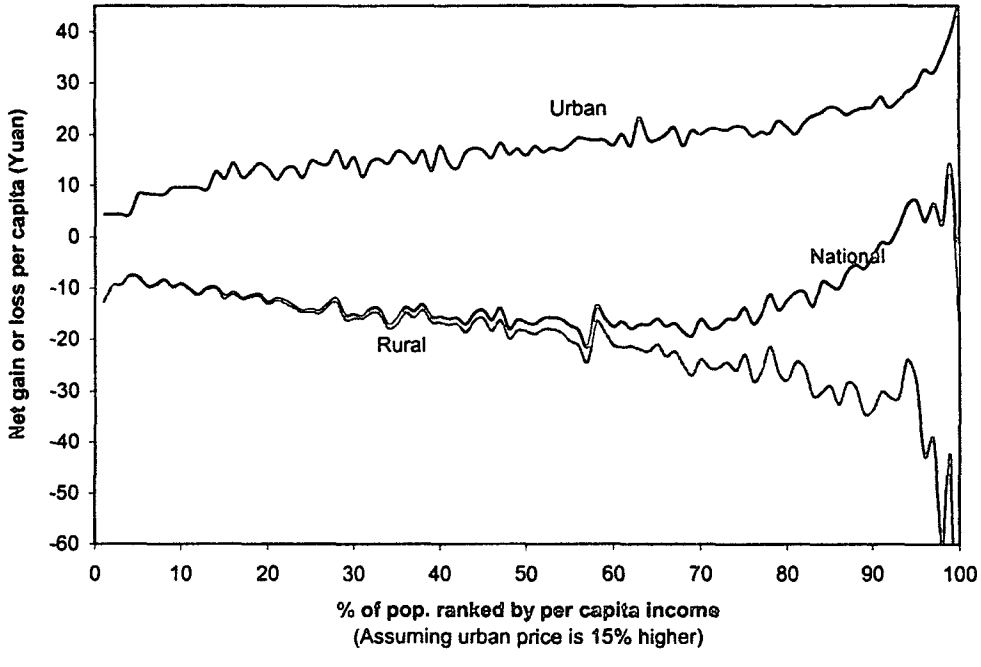

Figure 3b: Mean percentage gain by income percentile

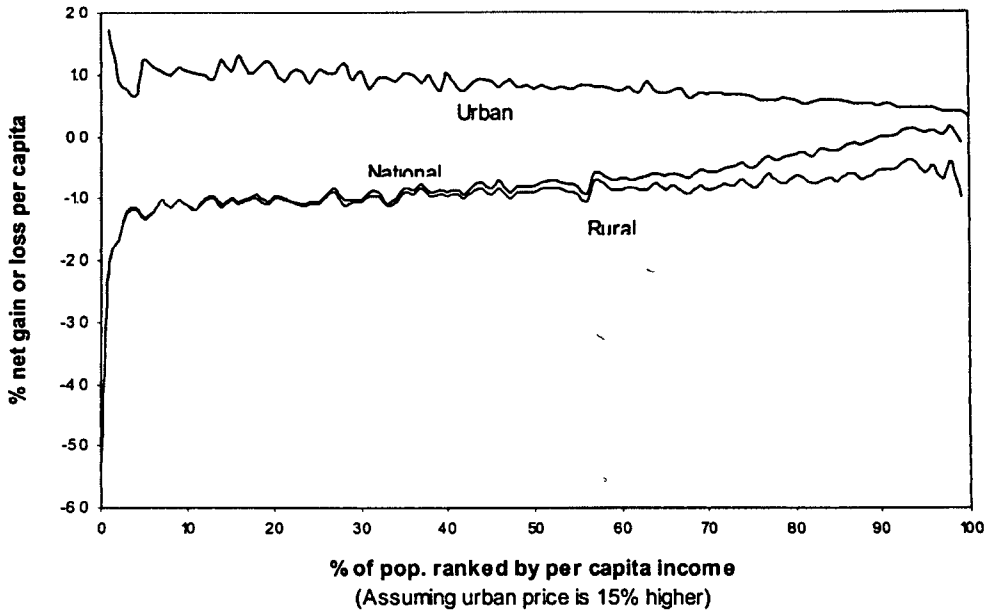

Figure 3c: Percentage of gainers by income percentile