# Welfare Analysis of the Chinese Grain Policy Reforms

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**Abstract** The Chinese grain policy reforms were implemented in 1994. The grain price subsidies were eliminated which led to a substantial grain price increase. This paper examines the welfare changes associated with the grain policy reforms. All welfare measures unambiguously show that the consumers became worse off after the implementation of the grain policy reforms. More interesting, however, is the comparison between the rich and poor consumers. Evidence suggests that the rich lost more than the poor in monetary terms. Finally, the analysis shows that income inequality in China went down after the grain policy reforms.

*Keywords*: China, grain reforms, welfare analysis

*JEL Classifications*: D31, D63, I38

## Introduction

The Chinese grain policy reforms were implemented in 1994. The subsidies for the grain price were eliminated which led to a substantial grain price increase. The reforms were needed to balance the government budget and restore market efficiency. Johnson (1994) examined the need of having such reforms and their possible consequences on the welfare of the Chinese consumers. Park, Rozelle, and Cai (1994) analyzed the implications of the grain policy reforms for equity, stabilization, and efficiency. Their analyses, however, were ex-ante. This paper examines the ex-post welfare changes associated with the grain policy reforms.

There is a continuing interest in analyzing the 1994 Chinese grain reforms. Aubert (1997) stated that the grain trade reforms are "unfinished story of state vs. peasant interest." Cheng (1997) analyzed the market reforms and the provisions of credit for grain purchases in China. Cheng (1996a) and Wu and McErlean (2003) examined the grain marketing system reforms and their effect on the grain market. This paper analyzes the welfare aspect of the Chinese grain policy reforms.

The elimination of the grain price subsidies resulted in a reduction in the welfare of the Chinese households. This study quantifies in monetary terms the losses for the average household and for rich, middle-income, and poor households. We use various welfare measures to show the welfare changes after the grain policy reforms. We estimate a linear demand for grain and calculate the Marshallian welfare change for the grain price increase. We use the Marshallian measure and the Willig (1976) approximations to construct the bounds for the compensating and the equivalent variations. We also calculate the Vartia (1983) exact measure of compensated income. Finally, following King (1983), we calculate the equivalent incomes, equivalent gains, compensating gains, and cash gains for the grain policy reforms. We perform

the above analyses for the average household and the subsamples of poor, middle-income, and rich households.

The grain policy reforms were accompanied by fiscal reforms. Herschler (1995) argued, however, that the fiscal reforms had only a limited success and that a revision of the fiscal policy was needed. The money saved from the elimination of the grain price subsidies was used for the reduction of taxes and government deficit. Given the limited success of these offsetting benefits and the lack of reliable data, we do not include any redistribution effects in our analyses.

The grain policy reforms had a welfare effect not only on the individual consumers but also on the society as a whole. Therefore, it is important to consider the income inequality since it enters the social welfare function. Cheng (1996b) showed that differences in crop income are a major source of the income inequality. Therefore, we calculate the income inequality before and after the grain policy reforms.

All welfare measures unambiguously show that the consumers became worse off and quantify the losses associated with the grain policy reforms. More interestingly, the comparison between the rich, middle-income, and poor consumers shows that the rich lost more than the poor in monetary terms. Finally, the analyses show that the income inequality in China went down after the grain policy reforms.

The data used in this paper were obtained from the State Statistical Bureau (SSB). The Bureau conducted a rural household survey in Jiangsu Province, China in 1993 and 1994. This database includes six counties in the southern part of the province with a total of 592 households in 1993 and 584 households in 1994. The survey provides the average grain price paid by the households, the quantity of grain consumed, and the household income.

## Marshallian Welfare Change for the Grain Policy Reforms

The easiest way to get an idea of the impact of the grain price change is to calculate the Marshallian measure of a welfare change. For computational convenience we assume a linear demand function. We regress the quantity of grain consumed on the grain price and the household income. Table 1, panel A shows the results from a regression using the 1993 data. The results using the 1994 data and the combined 1993 and 1994 data are qualitatively similar. Therefore, we assume that the demand curve does not shift after the grain policy reforms. Using the regression coefficients of the linear demand equation and the average values of the grain price, grain consumed, and household income, we calculate the price and income elasticities of grain. The results are shown in table 1, panel B.

We assumed that the grain policy reforms will not shift the demand curve for grains. Therefore, the new equilibrium point for the grain market is a point on the demand function corresponding to the new grain price. Figure 1 illustrates the price change and shows the area of the Marshallian welfare change for consumers. The Marshallian welfare change is calculated according to the following formula:

$$M = \frac{(p^1 - p^0)(z^1 + z^0)}{2} \tag{1}$$

where $p^0$ and $p^1$ are the grain prices before and after the reforms, $z^0$ is the quantity of grain consumed before the reforms, and $z^1$ is the estimated grain quantity consumed after the reforms.

The Marshallian welfare changes are presented in table1, panel C. The average, poor, middle-income, and rich households lost from the implementation of the grain policy reforms: the average household lost 381.25 Yuans, the poor lost 313.85 Yuans, the middle class lost 366.42 Yuans, and the rich lost 490.17 Yuans. Moreover, the results show that the rich lost more than the middle class, which lost more than the poor. The results are qualitatively the same whether we use household income before or after the reforms.

## Willig Approximations of the Compensating and Equivalent Variations of the Grain Price Change

The Marshallian measure of a welfare change is a good illustrative tool and is easily estimated from the observable data on prices, quantities, and incomes. The Marshallian measure, however, is not a correct theoretical measure of a welfare change. The correct measures are the compensating and the equivalent variations. Since the exact calculation of the compensating and equivalent variations requires data on the utility levels of the households, Willig (1976) proposed some simple bounds for the compensated and the equivalent variations estimable from observable data on the quantities, prices, and incomes. The proposed bounds are valid if two conditions are satisfied:

$$\left|\frac{\eta M}{2m^0}\right| < 0.05 \text{ and } \left|\frac{M}{m^0}\right| < 0.9 \quad (2)$$

where $\eta$ is the income elasticity of the demand, $M$ is the Marshallian change under the demand curve and between the two prices, and $m^0$ is the income before the reforms. The restriction values using our data are shown in table 1, panel C. All of the restrictions are satisfied. Therefore, we can apply the following formula for the approximating error:

$$\text{Willig error} = \frac{\eta M^2}{2m^0} \quad (3)$$

where the notations are same as above. The result in table 1, panel C indicates that the Willig errors are 1.23 Yuans for the average household, 4.82 Yuans for the poor household, 1.55 Yuans for the middle household, and 0.58 Yuans for the rich household. We obtain the compensating and the equivalent variations by subtracting and adding the Willig errors to the Marshallian welfare change. Even when the Willig error is the largest and the Marshallian change is the smallest in the case of the poor household, we need 1.53% adjustment to the Marshallian change to obtain the compensating and equivalent variations. Therefore, the calculated Marshallian measure can be used as a reasonable approximation of the correct compensating and equivalent variations.

**Vartia's Exact Calculations of the Compensated Income after the Grain Price Change**

Whereas Willig found approximation bounds of the Hicksian measure of a welfare change, Vartia (1983) proposed a method of calculating an exact Hicksian measure of a welfare change. An arbitrary fine approximation of the compensated income is found by using numerical methods and setting an appropriate convergence level. The post-change compensated income is the money each household requires to keep the post-change indirect utility equal to the pre-post indirect utility.

We assume the same linear demand function for grain and use the coefficients estimated in table 1, panel A. Following Vartia (1983), we assume a step-wise linear price path for the grain price change from the year before the reforms to the year after the reforms. The linear grain price path and the initial values of the grain price and household income are shown in table 2. Starting with the grain price and income before the reforms, we estimate the quantity of grain demanded using the estimated demand function. Then we move step by step on the indifference surface and approach the compensated demand. The compensated income after the price change is found by iterating the following formula for the initial values which are the final values of the previous step:

$$m^{k+1} = m^k + \frac{1}{2}\left[ z(p^k, m^k) + z(p^{k+1}, m^k) \right](p^k - p^{k-1}) \tag{4}$$

where $z(p,m)$ is the quantity of grain demanded as a linear function of the grain price and the household income and $k$ is the number of iteration steps. The results of this procedure are shown in table 2. The results show that even with a compensation that keeps the level of utility constant, there is a substitution away from the grain consumed reflecting the increase of price for a normal good. Halbrendt, Tuan, Gempesaw, and Dolk-Etz (1994) showed that the commodity substitution due to relative price change is small, except in the case of grain. The compensated income of the average household rises from 8491.3 Yuans before the grain price change to 8862.7 Yuans after the grain price change. Therefore, the average Chinese household will require 371.4 Yuans to keep its post-reform indirect utility equal to its pre-reform indirect utility. The poor will require 288.6 Yuans, the middle class 353.3 Yuans, and the rich 485 Yuans of compensation to be as well off as before the reforms. The fact that the rich require highest compensation means that they lost the most from the grain policy reforms.

Since this methodology does not account for the actual change in income, we should compare it with the Marshallian measure that is based on the pre-reform income. Note that the values of the compensated income are very close to the Marshallian measure of the welfare change using the pre-reform income. The difference between the compensated income and the Marshallian measure is even smaller than the Willig (1976) approximating errors of the previous section. Thus, the welfare measures used in this paper are interrelated and consistent with each other.

**King's Calculations for the Gains/Losses after the Grain Policy Reforms**

The analysis in the previous sections assumed that the household income is exogenous and not influenced by the elimination of the grain price subsidies. Naturally, the elimination of

the grain subsidies leads to savings for the government. There are many ways in which the government can use the savings from the subsidy cut. At one extreme is the unrealistic case in which the government decides to use the money saved for some activities that are unrelated to the life of the households in our sample. At the other extreme is the King's type of reform in which the government distributes all the money saved from the elimination of the grain subsidies to the households in the form of tax cuts according to a certain rule. Finally, the realistic outcome is that the government provides some packages of additional services to the households. Unfortunately, finding out what part of the services provided to the households after the reforms was financed with the money saved from the subsidy cut and what part was financed with other funds is hard to determine. Therefore, without additional information or assumptions the welfare change is hard to guess.

We follow King's methodology and attempt to estimate the equivalent, compensating and cash gains from the grain price increase. Since we do not have additional information, we will consider the unrealistic case that the government spends the savings on unrelated activities for the households in our sample. The results can be interpreted as a lower bound of the welfare losses of each household. We assume that there are two goods – grain and other food. The following demand function is estimated using the available data:

$$z_g = \frac{m}{p_g}\left[b_1 + b_2 \log\left(\frac{p_g}{p_f}\right)\right] \tag{5}$$

where $p_g$ is the grain price, $p_f$ is the price of other food, $m$ is the household income, $z_g$ is the quantity of grain demanded, and $b_1$ and $b_2$ are parameters to be estimated. The results are shown in table 3. The following equivalent income function corresponds to the above demand function:

$$m_g = m\left(\frac{p_g^R}{p_g}\right)^{b_1}\left(\frac{p_f^R}{p_f}\right)^{1-b_1}\exp\left(\frac{b_2}{2}\left\{\left[\log\left(\frac{p_g^R}{p_f^R}\right)\right]^2 - \left[\log\left(\frac{p_g}{p_f}\right)\right]^2\right\}\right) \tag{6}$$

where $R$ is 0 for the pre-reform prices, or 1 for post-reform prices. The equivalent income, the compensating income, and the cash gain are determined as

$$EG = m(p^0, p^1, m^1) - m^0,$$

$$CG = m^1 - m(p^1, p^0, m^0), \tag{7}$$

$$G = m^1 - m^0 - (p^1 - p^0)z^0,$$

where the previous notation applies. The results in table 3 show that the average household had a loss of 258.09 Yuans, the poor household lost 268.75 Yuans, the middle-income household lost 340.33 Yuans, and the rich household lost 372.80 Yuans from the grain price increase. Again, the rich lost more than the poor. These numbers, however, should be interpreted with caution given the unrealistic assumption that the government did not provide some offsetting benefits to

the households for the grain price change. Due to the different functional forms of the demand function, the results here differ from the results in the previous sections.

## Income Inequality in China Before and After the Grain Policy Reforms

We established that all households lost from the grain price increase with the rich households losing more than the poor households. When calculating the welfare changes for the individual consumers we took into account the changes in their incomes. To analyze a welfare change for the society as a whole, we also need the change in the income inequality. Of course, a change in the income inequality would not mean that the change is solely because of the grain policy reforms. However, the income inequality change is an important factor in understanding the social welfare change in China.

We estimate the income inequality by drawing a Lorenz curve and calculating the Gini coefficient. The Lorenz curve plots the number of the households (ordered from lowest to highest income) on the horizontal axis and their cumulative income on the vertical axis. The equality line (the 45-degree line) assumes that all households have the average sample income. Figure 2 shows the pre- and post-reform Lorenz curve and the equality lines. The Gini coefficient is calculated as the area between the Lorenz curve and the equality line divided by the triangular area under the equality line. The Gini coefficient measures the income inequality: a coefficient of zero is a perfect equality, and a coefficient of 1 is a perfect inequality. The calculated Gini coefficient of income inequality is 0.308 in 1993 and 0.29 in 1994. Therefore the income inequality went down after the grain policy reforms. The fact that the income inequality was reduced after the implementation of the grain policy reforms is consistent with our findings that the rich lost more than the poor.

## Summary and Conclusions

The Chinese grain policy reforms of eliminating the grain price subsidies led to a 47% grain price increase in 1994. We used several welfare measures to show the losses of the average, average poor, average middle, and average rich households in Jiangsu Province, China. Using the Marshallian welfare measure we found that the average household lost 381.25 Yuans, the poor lost 313.85 Yuans, the middle class lost 366.42 Yuans and the rich lost 490.17 Yuans. The Willig approximating error bounds for the compensating and equivalent variations were calculated by subtracting and adding to the Marshallian measure 1.23 Yuans for the average household, 4.82 Yuans for the poor household, 1.55 Yuans for the middle household and 0.58 Yuans for the rich household. Vartia's exact compensated income was even closer to the Marshallian measure calculated with the pre-reform income. The exact compensation required was 371.4 Yuans for the average household, 288.6 Yuans for the poor household, 353.3 Yuans for the middle household, and 485 Yuans for the rich household. King's methodology was applied to derive the lower bound of the welfare losses. The average household had a cash loss of 258.09 Yuans, the poor household lost 268.75 Yuans, the middle household lost 340.33 Yuans, and the rich household lost 372.80 Yuans from grain price increase. All welfare measures unambiguously show that all households lost from the grain price increase. Moreover, the evidence shows that the rich lost more than the poor. Finally, we estimated the Gini coefficient

of income inequality to be 0.309 in 1993 and 0.29 in 1994. The income inequality generally affects the social welfare of the society as a whole. We conclude that although all consumers became worse off, the rich lost more than the poor, and the income inequality went down after the grain policy reforms.

The Chinese grain policy reforms were needed to balance the government budget and restore market efficiency. The elimination of the grain price subsidies led to a substantial increase in the grain price. Therefore, all consumers were hurt by the implementation of the grain policy reforms. However, our analysis shows that the rich lost more in money terms than the poor, which reduced the inequality between the rich and the poor. The reduction in the inequality of the rich and the poor rural households is a desirable outcome of the policy reforms even though all consumers were hurt.

This paper presents the welfare effects a year after the implementation of the grain policy reforms. In the short-run (one year), the consumers were hurt from the grain price increase. In the long-run, however, the liberalization in the grain trade and production and the efficiency in the rural economy will lead to some offsetting benefits to the consumers in the form of future lower prices.

Several authors (Aubert, 1997, and Herschler, 1995) indicated the need for more reforms and a revision of the current policies. As more reforms are implemented or policies are revised, more studies will be needed to analyze the consequences of these reforms.

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Table 1. Regression Results, Mashallian Change and Willig Error Bounds

| | Average Household | Poor Household | Middle Household | Rich Household |
|---|---|---|---|---|
| *Panel A: Regression of grain consumed on grain price and income* | | | | |
| Constant | 1123.68 | 758.30 | 1185.24 | 1265.17 |
| | (22.58) | (6.74) | (5.52) | (13.43) |
| Grain Price | -328.84 | -286.13 | -467.23 | -260.20 |
| | (-6.81) | (-4.31) | (-4.53) | (-3.07) |
| Income | 0.0166 | 0.0838 | 0.0240 | 0.0054 |
| | (6.67) | (3.99) | (0.88) | (1.40) |
| *Panel B: Price and income elasticities* | | | | |
| Price elasticity | -0.29255 | -0.30143 | -0.41342 | -0.20005 |
| Income elasticity | 0.14404 | 0.416391 | 0.178594 | 0.068201 |
| *Panel C: Marshallian change and Willig error bounds* | | | | |
| Marsh. change ($m^0$) | -370.63 | -286.06 | -352.26 | -484.27 |
| Marsh. change ($m^1$) | -381.25 | -313.85 | -366.42 | -490.17 |
| Restriction (<0.05) | 0.00323 | 0.01535 | 0.0044 | 0.00119 |
| Restriction (<0.9) | 0.0449 | 0.07371 | 0.04929 | 0.03491 |
| Willig error bounds | 1.23 | 4.82 | 1.55 | 0.58 |

Note: The numbers in parentheses are t-statistics.

Table 2. Compensations Using Vartia's Methodology

| Steps | Grain Price Change | Compensated Demand | Compensated Income |
|---|---|---|---|
| *Panel A: Average Household* | | | |
| 0 | 0.8704 | 978.38 | 8491.3 |
| 1 | 0.9720 | 944.95 | 8589.1 |
| 2 | 1.0737 | 913.15 | 8683.5 |
| 3 | 1.1753 | 881.29 | 8774.7 |
| 4 | 1.2770 | 849.38 | 8862.7 |
| | | | Compensation: 371.4 |
| *Panel B: Poor Household* | | | |
| 0 | 0.9026 | 856.79 | 4257.8 |
| 1 | 0.9913 | 831.40 | 4332.7 |
| 2 | 1.0800 | 812.29 | 4405.6 |
| 3 | 1.1688 | 793.01 | 4476.9 |
| 4 | 1.2575 | 773.59 | 4546.4 |
| | | | Compensation: 288.6 |

Table 2. Compensations Using Vartia's Methodology (Continued)

| | | | |
|---|---|---|---|
| | *Panel C: Middle Household* | | |
| 0 | 0.8493 | 959.84 | 7146.4 |
| 1 | 0.9512 | 912.25 | 7241.7 |
| 2 | 1.0530 | 866.95 | 7332.3 |
| 3 | 1.1548 | 821.54 | 7418.3 |
| 4 | 1.2567 | 776.01 | 7499.7 |
| | | | Compensation: 353.3 |
| | *Panel D: Rich Household* | | |
| 0 | 0.8594 | 1117.8 | 14042 |
| 1 | 0.9738 | 1088.1 | 14168 |
| 2 | 1.0882 | 1059.0 | 14291 |
| 3 | 1.2026 | 1029.9 | 14410 |
| 4 | 1.3170 | 1000.8 | 14527 |
| | | | Compensation: 485 |

Table 3. Gains Using King's Methodology

| | | Average Household | Avg. Poor Household | Avg. Middle Household | Avg. Rich Household |
|---|---|---|---|---|---|
| Estimated | $b_1$ | 0.0774 | 0.1831 | 0.1200 | 0.0591 |
| coefficients | | (28.74) | (33.59) | (31.58) | (18.92) |
| in King's | $b_2$ | 0.0888 | 0.22 | 0.1269 | 0.0612 |
| regression | | (7.00) | (10.37) | (7.41) | (4.03) |
| Original | $m^0$ | 8491.47 | 4257.78 | 7146.37 | 14042.03 |
| budget | $p_g^0$ | 0.8704 | 0.9026 | 0.8493 | 0.8594 |
| sets | $p_f^0$ | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| Post-Reform | $m^1$ | 8491.47 | 4257.78 | 7146.37 | 14042.03 |
| budget | $p_g^1$ | 1.2770 | 1.2567 | 1.2567 | 1.3170 |
| sets | $p_f^1$ | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| Consumption | $z_g^0$ | 634.76 | 757.26 | 835.36 | 814.68 |
| of grains | $z_g^1$ | 659.08 | 790.92 | 847.20 | 810.34 |
| Equivalent | $m_e^0$ | 8762.8 | 4545.3 | 7502.5 | 14424 |
| incomes | $m_e^1$ | 8228.3 | 3988.5 | 6807.1 | 13670 |
| Equivalent gain | *EG* | -263.04 | -269.33 | -339.27 | -372.20 |
| Compens. gain | *CG* | -271.45 | -287.52 | -356.17 | -382.33 |
| Cash gain | *G* | -258.09 | -268.75 | -340.33 | -372.80 |

Note: The numbers in parentheses are t-statistics. m is income, $p_g$ is a grain price, $p_f$ is the price of a "composite" commodity of other food.

Figure 1. Willig-Style Approximations

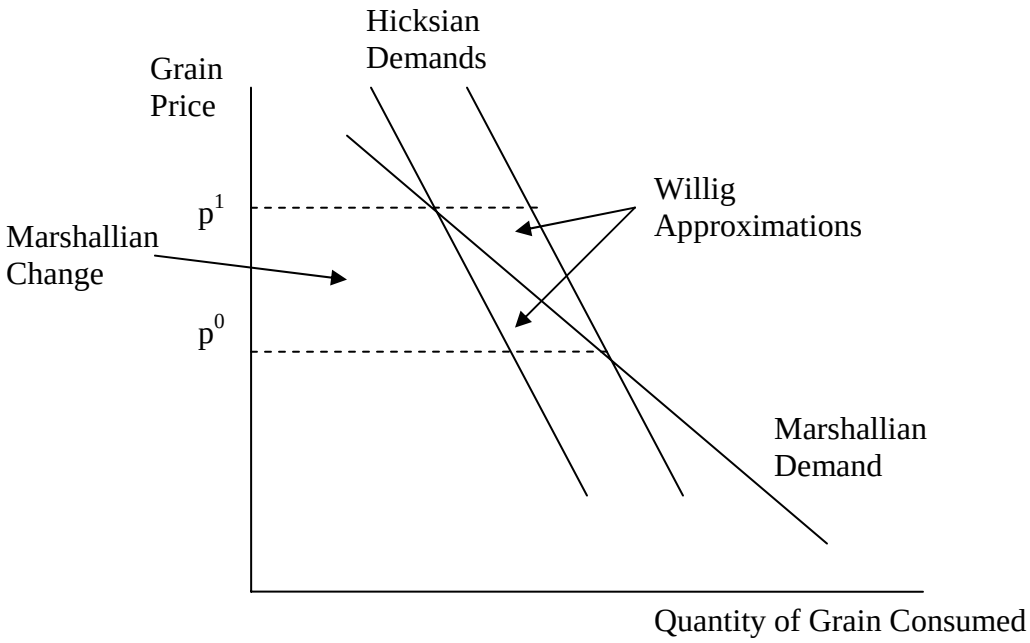

Figure 2. Lorenz Curve for Income Distribution Before and After the Reform