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**Impacts of the Global Food Price Crisis on Household Welfare and  
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# **Impacts of the Global Food Price Crisis on Household Welfare and Poverty in Lao PDR**

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## **Abstract**

This paper evaluates the impacts of the 2007-2008 food price crisis, especially price increases of rice, on household welfare and poverty in Laos that is atypical in that glutinous rice is the main staple. With a nationally representative household survey, net sellers and buyers of ordinary and glutinous rice are identified, and consumer and producer price data are analyzed. The study found that the impact of the food price crisis in 2007-2008 was negligible. This is mainly because the role of ordinary rice in sales and purchases in Laos is not as significant as in other Southeast Asian countries. However, with hypothetical higher growth rates for increases of glutinous rice, the change in household welfare for the average Lao household is neutral, but it is positive in rural areas and negative in urban areas.

**Keywords: food price crisis, Lao PDR, poverty, household welfare, glutinous rice**

**JEL code: I32, O12, O13, Q12, Q18, N55, D12**

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## 1. Introduction

Food prices are an important economic issue in any country, and are especially important in developing countries, since those countries have more poor households, which tend to spend a relatively large proportion of their incomes on food consumption and often production of food crops. FAO data show that international crop prices displayed extremely high price increases during the food price crisis that occurred from 2007 to 2008. From January, 2007 to their peak in 2008, international commodity prices increased about three-fold for rice, about two and a half times for wheat and two-fold for soybeans and maize (Piesse and Thirtle, 2009). These international commodity price increases are steeper than the increases that occurred in domestic markets, but domestic commodity prices also rose in many developing countries during this period. For example, in Vietnam, the consumer price of staple foods (mostly rice) increased by 15 percent in 2007 and 78 percent in 2008 (Vu and Glewwe, 2011). In Cambodia, the consumer price of rice doubled from 2007 to 2008 (Vu and Glewwe, 2009). In Thailand, the wholesale price of rice increased by 88 percent from 2007 to 2008 (Timmer, 2010).

The impact of the increase in rice prices on Southeast Asian countries has been documented in several studies. Ivanic and Martin (2008a) estimated the impact of the global food price increases from 2005 to 2007 on poverty rates in nine developing countries. They estimate that the poverty rate increased by 1.4 percentage points in Cambodia as a whole, and by 1.4 and 1.2 percentage points in rural and urban areas, respectively. In addition, the poverty rate decreased by 1.4 and 1.9 percentage points in Vietnam as a whole and rural Vietnam, respectively, but increased by 0.3 percentage points in urban Vietnam. In contrast to Ivanic and Martin (2008a), who used the growth rates in international food prices from 2005 to 2007, Vu and Glewwe (2009, 2011) used the domestic rice price changes from 2007 to September 2008 in

Vietnam and cereal price changes in 2008 in Cambodia (an 88 percent increase) to estimate changes in welfare and poverty rates in those two countries. Their Vietnam study found that, on average, household welfare, as measured by household expenditures, increased by 5 percent, but they also found that the poverty rate increased by 0.3 percentage points. Household welfare increased by 7.6 percent and decreased by 2.8 percent in rural and urban areas, respectively, and the poverty rates decreased by 0.1 percentage points and increased by 1.3 percentage points in rural and urban areas, respectively. For Cambodia, they found that household welfare increased by 4 and 6 percent in Cambodia as a whole and rural Cambodia, respectively, and decreased by about 4 percent in urban areas. The poverty rates decreased by 0.3 percentage points in Cambodia as a whole, and by 0.9 percentage points in rural areas, but increased by about 1 percent in urban areas. These examples in Southeast Asian countries indicate that higher rice or cereal prices increase households' welfare to some extent, but the impact on poverty is not very large, and that the impacts on household welfare and poverty differ considerably between urban and rural areas.

When compared to analyses in neighboring countries, investigation of the impact of the food price crisis in Laos requires additional attention. First, Laos consumes and produces two varieties of rice: glutinous (sticky) and ordinary (non-glutinous) rice. Laos is atypical in that glutinous rice is the main staple, while ordinary rice is predominately consumed, and traded internationally, in the rest of Southeast Asia. The traded volume of glutinous rice is less than one percent in the world's trade in rice (Childs and Burdett, 2000), so it is hard even to find international prices for glutinous rice. One available approximation of international prices for glutinous rice is export prices in Thailand; the price of glutinous rice increased by 47 percent from January to September in 2008, while the price decreased by 8 percent for the two year

period from January 2007 to December 2008 (TREA, 2011), as shown in Figure 2. The price growth in glutinous rice is not as high as that for ordinary rice, but the Thai export glutinous rice prices indicate a potential price increase in glutinous rice, which could have a large impact on household welfare and poverty in Laos. Therefore, since Laos has a unique pattern in crop consumption and production, it should merit particular attention when studying the impact of the food price crisis in 2008.

The causes of this food price crisis have been analyzed by Piesse and Thirtle (2009) and Timmer (2010). The fear of food price increases still persists because of the prospect of higher demand for grains from rapidly growing developing countries with large populations, such as China and India, and increasing demand of grain for bio-fuel production. Indeed, this fear is rapidly becoming a reality again; in March 2011, the World Bank's food price index was 36% above its level a year earlier and close to its 2008 peak (World Bank, 2011). That World Bank report estimated an additional 44 million more poor in low- and middle income countries due to the rise in food prices since June 2010.

In Laos, World Bank (2009) discussed the impact of the food price crisis in 2008 by presenting the percentages of households that buy rice, that consume own produced rice, and that sell rice in each household category, using data collected in 2007/08. It concluded that urban households are the most affected by a price increase, and that the urban poor should be provided with some support if the price continued to increase. One problem with this method is that it does not look at the percentages of *net* buyers and sellers, and *these* percentages will identify the real victims and beneficiaries, not the overall percentages of (gross) buyers and sellers. In addition, it is not possible to measure the *sizes* of the impact which is measured by household expenditures, using the simple analytical method in World Bank (2009). This paper overcomes

the aforementioned issues and thus provides more insights into the possibility of a food price crisis in the future in Laos.

Though Laos has enjoyed significant economic growth in recent years (almost a six percent annual growth rate in real per capita GDP growth rate from 2005 to 2012), the role of the agricultural sector is still important. Although the current figure is almost certainly lower, 85 percent of the labor force was employed in agriculture in 1995 (World Bank, 2010). Laos is a land-locked country. The low level of integration of the domestic agricultural market due to a poor road network in rural areas, no national railroad systems and low population density, has been recognized as barriers to be overcome for agricultural development. In addition, the poor population is concentrated in rural areas; therefore, agricultural development is very important for Laos. In this context, analysis of the impact of global food price crises is important.

The rest of this paper is organized as follows: At first, changes in consumer prices for two kinds of rice in Laos during the food price crisis, and the method to estimate the growth rates of producer prices are presented. The second section explains the method used to estimate the impacts of a food price increase on household welfare and poverty, and describes the data used. The third section describes poverty in Laos and the patterns of consumption and production of two kinds of rice. The fourth section presents the results of the simulations using two hypothetical scenarios, and the actual price changes that occurred in 2008, in order to examine the impact of changing rice prices on household welfare, as measured by household expenditure, and on poverty. Finally, the last section summarizes the results and provides several conclusions.

### **1.1. Consumer and Producer Price Changes in Laos during the Food Crisis**

This section describes the changes in consumer prices for rice in Laos, and explains the method used to estimate producer prices. Both types of price changes must be considered to obtain the changes in household welfare and in poverty. Table 1 shows the yearly growth rates for the consumer prices of glutinous and ordinary rice in Laos in 2006, 2007 and 2008. Vientiane province (including the Vientiane Capital) is in the Central region in the CPI statistics.<sup>1</sup> As seen in the table, the growth rate of the ordinary rice CPI for the entire country in 2008 (22.9 percent) was much higher than those in 2006 and 2007 (1.4 and 7.0 percent, respectively). The growth rate in the North region did not jump by as much as it did in the Central and South regions. The growth rates in 2008 in the Central and South regions are 29.3 and 20.3 percent, respectively, so the timing of these price increases corresponds to the price spike in international rice prices in 2008 (Asian Development Bank, 2008, p.1). For Laos as a whole, the table also shows the growth rate of the price indices for food and non-food items. From 2006 to 2008, the prices of food and non-food commodities were stable, and the just-mentioned higher growth rates for glutinous and ordinary rice were much higher than the growth rates of the food and non-food price indices. Finally, note that although the increase in the price of ordinary rice in 2008 was much higher than in the previous two years, that growth rate was much smaller than the corresponding rate for the international market (as seen in Figure 1).

Compared with the high CPI growth rates in the price of ordinary rice, the growth rates of glutinous rice prices were much lower in 2008. This reflects the unusually high yields in glutinous rice in 2008.<sup>2</sup> The annual growth rates of glutinous rice prices in 2008 were 7.8 percent, 12.1 percent and 5.9 percent in the North, Central and South regions, respectively, as seen in Table 1. These growth rates were much lower than those in 2006 and 2007 in the Central and South regions, and than that in 2006 in the North. In spite of these smaller growth rates, the



impact on household welfare and poverty could be large because of the importance of glutinous rice as both a consumption good and an income source in Laos, as described below.

Unfortunately, unlike the CPI data, the producer price index (PPI) data, which are based on a survey of farm-gate prices, are not collected regularly and are not published by the government of Laos.<sup>3</sup> Although one way to obtain a PPI is to borrow data from a neighbor country that is similar to Laos, this study uses the village-level farm-gate prices of glutinous and ordinary rice that were collected in the (nationally representative) Lao Expenditure and Consumption Surveys that were collected in 2002/03 and 2007/08. Assuming a strong correlation between consumer and producer prices, the percentage change of the PPI with a one percentage increase in the CPI is called the elasticity of the PPI with respect to the CPI. The following formula is used to calculate that elasticity:

$$\frac{d\ln(P_{P_i})}{d\ln(P_{C_i})} = \frac{\ln(\text{Farm-gate price for rice in 07/08}) - \ln(\text{Farm-gate price for rice in 02/03})}{\ln(\text{Food CPI in 07/08}) - \ln(\text{Food CPI in 02/03})}$$

The means over households of this elasticity are calculated for 11 sub-regions from 2002/03 to 2007/08. The elasticities are shown in the third and fourth columns of Table 2. As a result, the estimated PPI growth rates can be calculated as in the fifth and sixth columns of the table. For both types of rice, the numbers are very different across regions except for those between the Vientiane province and the rest of the Central region.

Although a different analysis is necessary in order to determine why this difference happens, this regional difference in the growth rates of the CPI and the PPI is not surprising since the lack of integration in agricultural markets in Laos has been documented in World Bank (2006) and in a slightly older analysis by Takamatsu (2002). The pattern that the growth rates of the CPI and the estimated PPI are very different except for between Vientiane province and the Central region, supports the findings that the rice markets in Vientiane province and the Central

region are more integrated, and that the markets in the North and South regions are separated from each other and from Vientiane and the Central region.

Another plausible conjecture is that different regions are affected by different international markets. For example, since the border in the North region is with China, Vietnam and Myanmar, the influence of the agricultural markets in these countries on the North region can be stronger than that from the other parts of Laos.<sup>4</sup> The Central region including Vientiane province, and the South region are more affected by the agricultural markets in northern Thailand because the border of these areas faces Thailand.

An additional factor which is likely to explain the different patterns in regional price differences is the patterns in rice production (and demand). The Central region including Vientiane is the rice-surplus region, so rice from the Central region is distributed to the rice-deficit North and South regions. It is possible that the producer price is more responsive to a consumer price increase in those locations, where the demand for rice is both high and often not satisfied. As seen in Tables 4 and 5, the values of net production (=value produced – value consumed) of glutinous and ordinary rice are negative in the North and South regions. Thus, this study makes additional simulations using the estimated PPI given high regional variability in Laos.

Finally, the producer prices for rice could be influenced by the activities of the State Food Enterprise (SFE). “The SFE procures rice during harvest for government staff and sells rice stocks during rice shortages. ... [T]he SFE is responsible for operating food procurement from farmers and traders in the central and Southern provinces in order to stabilize prices” (p.12 in Engvall et al., 2009).

A variety of factors can be considered as to why the estimated PPI growth rates are different across regions. Identifying the true reason(s) is not the purpose of this study, but the important implication of this section for this study is that one should consider the possibility of different growth rates for increases in producer and consumer prices.

## **2. Methods and Data**

This section explains how poverty and welfare are measured with household survey and produce and consumer price data, and then turns to more explanation on how the household survey data are used.

### **2.1. Measurement of Welfare Change**

The methodologies used by previous studies to estimate the impacts of a food price increase on poverty and welfare have varied according to the specific interests of these studies, the data available, and the types of impacts that were studied. For example, computable general equilibrium (CGE) analysis, such as the model developed by the International Food Policy Research Institute (e.g., Van Campenhout, Pauw, and Minot, 2013), the Global Trade Analysis Project (GTAP) model (e.g., Anderson et al., 2013) and others studies (de Hoyos and Medvedev, 2011; Marktanner and Noiset, 2013; and Warr and Yusuf, 2014) considers many possible routes for the impact of a food price change. However, since CGE analysis alone has difficulties in analyzing the detailed distribution within a country, a more detailed prediction is made by others using information from individual households collected by nationally representative household surveys (Ravallion and Lokshin, 2008 and Chen and Ravallion, 2004).

To analyze the distribution of the impact of a price increase, only a household survey is necessary. Following the approach in Deaton (1989), Vu and Glewwe (2009, 2011) and de Janvry and Sadoulet (2010), the following formula is derived:

$$\frac{dB_{hi}}{X_h} = \left( \frac{P_{ci} q_i^p}{X_h} - \frac{P_{pi} y_i^s}{X_h} \right) d \ln P_{ci} , \quad (1)$$

where  $B_{hi}$  is the money metric change in welfare due to the change for item  $i$ ;  $X_h$  is the total household expenditure;  $P_{ci}$ , and  $P_{pi}$ , are the consumer and producer prices for item  $i$ , respectively; and  $q_i^p$  and  $y_i^s$ , are the quality of purchase and sales for item, respectively. The LHS of the formula measures the change in household welfare measured by the percentage of the total expenditure. The bracket on the RHS is the net purchase (=purpose-sales) measured by the percentage of the total expenditure.  $d \ln P_{ci}$  is the change in the consumer price for item  $i$ .

Households whose values of sales of an item are larger than those of purchases of the item are called net sellers. By contrast, households whose values of sales of an item are smaller than those of purchases of the item are called net buyers (net purchasers). According to Equation (1), welfare of net sellers increases and that of net buyers decreases with a price increase. The fractions of net sellers and buyers represent the distribution of winners and losers from a price increase.

Thus far, it is assumed that the growth rates of consumer prices are equal to those of producer prices. In order to consider the case in which this assumption does not hold, another formula to calculate welfare changes is introduced. Without this assumption, the formula to measure the welfare changes is obtained from the above equation:

$$\frac{dB_{hi}}{X_h} = \left( \frac{P_{ci} q_i^p}{X_h} - \frac{P_{pi} y_i^s}{X_h} \frac{d \ln P_{pi}}{d \ln P_{ci}} \right) d \ln P_{ci} . \quad (2)$$

This formula implies that the extent to which net consumer households lose their welfare from a price increase, and net seller households gain from a price increase, must take into account the relationship between producer price changes and consumer price changes. The term  $\frac{d\ln(P_P)}{d\ln(P_C)}$  represents the percent change in the PPI that corresponds to a one percent change in the CPI, which is called the elasticity of PPI with CPI in this study. Note that this study does not claim that the change of CPI causes that of PPI, rather the relationship above is considered to be a correlation.

A so-called second-order effect of the welfare change due to a price change is not considered in this study. The second-order effect is the change in welfare which comes from the changes in the quantity demanded and the quantity produced due to a price change (Caracciolo, Depalo and Brambila, 2014; de Janvry and Sadoulet, 2010; Friedman and Levinsohn, 2002; Minot and Goletti, 2000; Van Campenhout, et al., 2013; Vu and Glewwe, 2011). In these studies, the second-order effects, that is the price elasticities of demand and supply, are used. The two kinds of elasticities can be taken from conventional values as in de Janvry and Sadoulet (2010) or be estimated as in Vu and Glewwe (2011), Minot and Goletti (2000) and Friedman and Levinsohn (2002).

To the best of my knowledge, the two elasticities in Laos are not available in previous studies.<sup>5</sup> As explained in Ivanic and Martin (2008a), the bias from not including the second-order effect should be small. Also, the price elasticity of demand should be small since rice is a staple food. Also, given the short-lived price shock, the elasticity of supply is not large since the adjustment from a price change tends to take time and so is likely to be small. For example, in

Vu and Glewwe (2011), the sizes of welfare changes using the second-order effect using the price elasticity of demand are almost the same as those not using it.

## 2.2. Change in Poverty due to Change in Household Welfare

The methods used to obtain the change of poverty due to a price increase can be categorized into three types. The first type adjusts poverty lines to measure a short-term impact given the distribution of household expenditure or income. The change of poverty lines reflects the change of the purchasing power of poor and non-poor households. This approach considers only the impact on households in their roles as consumers (Dessus, Herrera, and De Hoyos, 2008). On the other hand, two other approaches consider the impact through an *income* change due to a change in food prices in addition to the effect as consumers. The first of these methods calculates the welfare change due to the price change using the equivalent variation, while the second calculates the income change and the resulting welfare change (de Janvry and Sadoulet 2010). The second and third methods are essentially the same since the second method quantifies the loss of utility due to a price increase and changes expenditures corresponding to the loss, and the third quantifies the loss of utility by adjusting poverty lines. Therefore, the loss of utility with a price increase yields a decrease in expenditures in the second method and higher poverty lines in the third method. Since the two approaches gives similar results, the second method is used in this study.

As in Vu and Glewwe (2009, 2011), new and old expenditure are related as follows:

$$X_h^{new} = X_h^{old} - dB_h . \quad (3)$$

As mentioned above, this welfare change is equivalent to a pre-paid cash transfer a household receives (or loses) to compensate for the future welfare loss (or gain) due to the price change as specified above. With a new level of household expenditure, the poverty under the new set of prices is defined by:

$$HC_h^{new} = \begin{cases} 1 & \text{if } X_h^{new} < Z^{old} \\ 0 & \text{if } X_h^{new} \geq Z^{old} \end{cases} \quad (4)$$

Note that poverty lines,  $Z^{old}$ , are not adjusted with the price change since the welfare change is measured using the equivalent variation, which uses the prices before the change.

### 2.3. Household Survey Data

In order to assess the impact of the sharp rice price increases on household welfare and poverty in Laos, this study mainly uses data from the 2007-2008 Lao Expenditure and Consumption Study (LECS), which was conducted from April, 2007 to March, 2008. The LECS is a nationally representative household survey with detailed data on household consumption, agricultural and economic activity, and on household and individual characteristics. The survey covered 8,926 households, of which 6,232 lived in rural areas and 2,064 lived in urban areas. The price data used in this study are from two sources: a monthly consumer price index which is collected by the Department of Statistics in Laos for three regions: the North, Central, and South regions; and a village level survey that collected, among other things, paddy rice prices for the LECS in 2002/03 and 2007/08.

The consumption and production data were collected at the household level in the LECS survey. The consumption from purchase and own production was recorded in diaries for thirty days. The values of households' consumption were recorded by households using daily diaries, and when households found it difficult to record the value of consumption, the enumerators helped them to fill in the values by providing a price per unit in the nearest market according to

the instruction of the questionnaires. For the production data, the harvested volumes (in kg) of crops were recorded for both agricultural seasons (wet and dry). The harvested volumes of two kinds of paddy rice were transformed to the values using the farm-gate paddy prices which were collected from each village in the 2007/08 LECS, since the household data indicate that only 24 percent and 5 percent of households sold glutinous and ordinary rice, respectively. The sales values of crops were recorded only for the most recent agricultural season, so the sales values were recorded in either of the two agricultural seasons even though some households cultivated rice in both seasons. The percentages of households that did this were 6.7 and 0.49 percent for glutinous and ordinary rice, respectively. To remedy this problem, the sales were doubled if rice was cropped in both seasons.<sup>6</sup> A final complication regarding these data is that the values of consumption from own production are estimated by either the households or the enumerators. The values of purchase are more reliable since they are based on actual transactions of money.

In the analysis, 17 provinces are aggregated into one province (Vientiane) and three regions (North, Central and South). In the following analysis, eight sub-regions (four regions by urban or rural areas) are used to avoid too much detail. An analysis using 50 sub-provinces (17\*3-1) might be beneficial in capturing more diverse aspects, but the sample in each province is too small to obtain reliable results. The sample sizes of eight sub-regions are found in Table 3.

### **3. Rice Consumption and Production in Laos**

This section briefly explains poverty and agriculture in Laos to some context, and then turns to detailed explanations of production and consumption of glutinous and ordinary rice.

#### **3.1. Poverty, Farming and Food Consumption in Laos**



Table 3 describes the distribution of some household characteristics, including the incidence of poverty and farming, by location and by per capita expenditure quintiles in 2007/8. As seen in the table, the poverty rate in Laos is 28 percent. Poverty is higher in rural areas, especially in rural areas without road access. Across regions, the poverty rate is the highest in the North region, slightly lower in the Central region, and much lower in Vientiane and the South region. A further locational disaggregation into 11 location categories reveals that the range in poverty rates across the location categories is rather large, from 11 to 55 percent. A more detailed discussion of poverty in 2007/08 is found in Engvall et al. (2009).

In Laos, 88 percent of households are engaged in agricultural activities, which include livestock production and fishing as seen in Table 3.<sup>7</sup> In urban areas, this figure is 63 percent, while it is almost 100 percent in rural areas. The involvement in agriculture declines as household expenditure increases. This indicates that, in general, the majority of households in Laos are engaged in agricultural activity, and even in urban areas the percentage is very high. The table also shows the share of food in total expenditures. On average, 72 percent of expenditures go to food. In urban areas, the number drops to 65 percent, but it is much higher in rural areas (about 75 percent). In addition, but not surprisingly, the food share declines as expenditures increase.

### **3.2. Consumption and Production: Glutinous Rice**

Glutinous rice is the most important grain and staple food in Laos. In the entire country, the value of the consumption share for glutinous rice in food consumption is 37.9 percent<sup>8</sup>, and only 21.6 percent of the consumption comes from purchase, as seen in Table 4. Not only is the importance of glutinous rice in food consumption noteworthy, but the extremely low dependency on purchases, in other words the high self-sufficiency in glutinous rice, has important

implications for the impact of food price changes on household welfare. These numbers vary across regions and urban or rural areas, as indicated in the table. Regarding the share of glutinous rice expenditure in food consumption, the North, Central and South regions have much higher consumption ratios (from 39.5 to 41.3 percent) than Vientiane (21.9). In addition, rural areas have higher consumption ratios than urban areas (about 40.5 vs 27.7 percent). Rural Vientiane has a slightly lower share of glutinous rice consumption in food consumption than other rural areas.

Similarly, the fraction of glutinous rice consumption that is purchased differs across regions and between urban and rural areas. Not surprisingly, urban areas have a much higher purchase share (49.1 percent) than rural areas (about 10 percent). Across regions, Vientiane has the largest purchase share (55.9 percent), the Central and South regions have the second largest share (about 20 percent), and the North has the lowest (12.5 percent). Between rural areas with and without wet season road access, rural areas with road access have slightly higher shares of purchase than those without road access in the North and Central regions, but this difference is not found in the South. Between regions, the share of purchase is about 75 percent in Vientiane, the South region has the second largest share (55.8 percent), the Central has the third (41.8), and the urban areas in North have a considerably lower share (31.2 percent). Rural Vientiane has a slightly lower share (24.5 percent) than that in the urban North region. Obviously, glutinous rice consumption in urban areas relies more on the market than in rural areas, but both urban and rural Vientiane have higher dependency on the market than their counterparts in the other regions.

Glutinous rice is also important as an income source. The value of glutinous rice production is 47.2 percent of agricultural production including livestock and fishing in the entire country, as shown in Table 4. This ratio is higher in urban areas and rural areas with road access

than in rural areas without road access. Across regions, Vientiane has the largest ratio and the Central region, where rice cropping is most suited, has the second highest ratio, followed by the South and North regions. Thus, in Laos, glutinous rice is the most important grain and food item in both consumption and production.

### **3.3. Consumption and Production: Ordinary Rice**

Ordinary (or non-sticky) rice is also important in consumption and production in Laos, but to a much lesser extent than glutinous rice. As seen in Table 5, in the entire country, 6.3 percent of the food budget (including consumption from own-production) is devoted to ordinary rice, and 58.1 percent of that consumption comes from owner-produced rice. This means that, on average, the value of ordinary rice consumption is much smaller than that of glutinous rice, and that more than half of the consumption is from own production. Compared with glutinous rice, the dependency on the market is higher for ordinary rice. Looking across regions and urban or rural areas, the percentage of total consumption devoted to ordinary rice is higher in the North region, especially, in rural areas (10.6 and 12.4 percent, respectively), compared to the national average (6.3 percent). As seen in Table 5, wherever the share of ordinary rice production is higher, the share of ordinary rice in food consumption is higher. For example, in the rural North region where the role of ordinary rice in consumption is larger, the production of ordinary rice is more important (10.6 percent). In general, ordinary rice has a higher market dependency than glutinous rice, but its importance in consumption and production is much lower than for glutinous rice.

## **4. Results: Impacts of Rice Price Increases on Household Welfare and Poverty in Laos**

Two hypothetical scenarios are used to examine the impact of changing rice prices on household welfare, as measured by real household expenditure, and poverty. Scenarios (1) and (2) assume that the growth rates in the consumer prices of glutinous and ordinary rice are 20 and 40 percent, respectively. For these scenarios, the estimated growth rates of producer prices are used as presented in Table 2. The results with 20 and 40 percent producer price growth rates are not shown for briery but are very similar to what are shown henceforth.<sup>9</sup> The changes in household welfare and poverty using scenarios (1) - (2) are shown in Table 6. The fractions of households that are positively and negatively affected by the price changes are shown in Table 7.

#### **4.1. Impacts of Increases in the Price of Glutinous Rice**

The welfare of an average household increases by 0.2 and 0.3 percent with 20 and 40 percent increases in prices of glutinous rice, respectively, which means that, on average, households are unaffected by the price increases. Urban households are negatively affected by a price increase, as one would expect, while rural households enjoy an increase in welfare, but the sizes of both of these welfare changes are not very large. With a 40 percent price increase, urban households' welfare decreases by 1.5 percent while welfare increases by 1.1 and 0.8 percent for rural households with and without road access, respectively. The directions of these welfare changes are consistent with the fact that urban areas have fewer farmers than rural areas, and non-farmers are net buyers of rice.

The negative changes in welfare for urban households do not vary by quintiles. On the other hand, the positive change in welfare for rural households is larger for richer households, and it is largest for the 4th (richest) quintile, in contrast to being close to zero for the first and second quintiles. Therefore, the size of negative welfare changes is invariant over household wealth in urban areas, but the benefit of a price increase is skewed to richer households in rural

areas. As seen in Table 4, the value of net production tends to be larger for richer households in rural areas, while it tends to be smaller for richer households in urban areas.

The percentage decrease in welfare in urban areas due to a price increase is slightly larger for poor households than for the non-poor. On the other hand, the percentage increase in welfare in rural areas is slightly larger for non-poor households than for poor households. With a 20 (40) percent price increase, household welfare decreased by 0.7 (1.4) percent of expenditures for non-poor households and 1.0 (2.0) percent for poor households in urban areas, and in rural areas it increased by 0.7 (1.3) percent for non-poor households and 0.2 (0.4) for poor households.

As seen above, urban households are negatively affected by a price increase, but the sizes of the impact on welfare are similar among urban regions except for the urban North region. In urban areas, a 40 percent price increase reduces welfare by 1.8, 0.1, 1.8 and 2.4 percent of expenditure in Vientiane, the North, Central and South regions, respectively. The small decrease in the urban North region reflects its lower dependency on the purchase of glutinous rice, even in urban areas, as seen in Table 4.

As seen above, rural households benefit from an increase in the price of rice, but the variation in the increase in welfare across rural regions is larger than it is across urban regions. With a 40 percent price increase, welfare increases by 5.0, 0.9, 1.0 and 0.5 percent in rural Vientiane, the rural North, Central and South regions, respectively. Rural households in Vientiane have the largest benefit. This is because Vientiane is the most productive for glutinous rice (World Bank 2006)<sup>9</sup>. The increases in welfare among rural households in the South region is negligible even with a 40 percent price increase.

Thus, the change in household welfare for the average Lao household due to an increase in the price of glutinous rice is neutral, while it is positive in rural areas and negative in urban

areas. The sizes of the negative welfare changes for urban households do not differ very much by expenditure quintiles and regions, but the size of the positive welfare increases in rural areas display more variation, which reflects the differences in rice sales across household wealth groups and regions.

Next, consider how the poverty rate changes when the price of glutinous rice increases. The simulated poverty rates are very small at the national level as well as the urban and rural levels. The poverty rate increases by 0.3 percentage points, from a base of 27.6 percent, with 20 and 40 percent price increases, respectively. This is consistent with the above-mentioned observation that household welfare are not affected with the price increases. The percentage point changes in the poverty rate are 0.5(0.5), 0.4(0.3), -0.5 (-0.5) percentage points in urban areas, rural areas with road access, rural areas without road access, respectively, with a 20 (40) percent price increase.

Across the four rural regions, one find that the poverty rate decreases only in Vientiane, but it increases very slightly in the rest of rural regions. The poverty rate decreases by 1.0 percentage point in rural Vientiane with a 20 and 40 percent price increase. In the rest of rural regions, the poverty rates increase by about 0.5 percentage points. For urban regions, the increase in the poverty rate is larger in urban Vientiane since the fraction of net buyers is 47 percent, which is much larger than that of net sellers in Vientiane, although the difference of the fractions between net buyers and sellers is smaller in the other regions, as seen in Table 7.

#### **4.2. Impacts of Increases in the Price of Ordinary Rice**

Table 6 shows that the sizes of welfare changes are within plus or minus 0.2 in most household groups. Only a few household groups are worth noting. With a 20 and 40 percent price increase

for ordinary rice, household welfare increases by 0.5 and 1.0 percent of total expenditures in rural Vientiane, decreases by 0.2 and 0.4 in urban Vientiane, and decreases by 0.2 and 0.4 percent for the urban poor, respectively. The sizes of the change in poverty rates are also negligible in all groups. These almost negligible changes in welfare and poverty for ordinary rice are due to the small scale of sales and purchases compared to total consumption. This finding indicates that the importance of ordinary rice is very limited in Laos, which is very different from the other countries in Southeast Asia.

### **4.3. Impact of Food Price Increases in 2008: Ordinary Rice**

As mentioned in 1.1, the growth rates of the increase in the price of ordinary rice were much higher than for the previous two years except for the North region. This corresponds to the price trend in the international (non-glutinous) rice market prices during the food price crisis of 2008, although the sizes of the growth rates are not as high as those for neighboring Southeast Asian countries. As seen in the analysis in 4.2, the impact of increases in the price of ordinary rice is expected to be very limited. Table 8 shows the percentage changes in welfare and percentage point changes of the poverty rate due to the increase in the price of ordinary rice in 2008 when the estimated PPI is used.<sup>9</sup> The sizes of the changes in welfare and poverty with the price increase are extremely small except for a few household groups. Household welfare decreased by 0.3 percent for urban poor households, rural Vientiane and the rural South region, but the sizes of decreases are almost negligible. For the change in poverty, the rate changes are no more than 0.1 percentage points in all groups.

## 5. Conclusions

This paper has studied the impacts of increases in the prices of two kinds of rice, glutinous and ordinary rice, in Laos. First, the potential impacts on household welfare and poverty were estimated using two different assumptions on size of the increases. Then, the impacts of the actual rice price increases for ordinary rice that occurred in 2008 were examined. As seen above, the impact of increases in the price of ordinary rice, the price of which was strongly affected by the food price crisis in 2007-2008, was negligible. This is mainly because the role of ordinary rice in sales and purchases is not as significant in Laos as it is in other Southeast Asian countries. As mentioned above, the staple in Laos is not ordinary rice but glutinous rice.

While the estimated effects of the growth rates of glutinous rice prices would not be significant, mostly because the low price increase in glutinous rice in 2008, as discussed in the simulated price increases, if the price increase of glutinous rice had been higher than its actual growth rate in 2008, the changes in household welfare and poverty would not have been negligible.

This paper's contribution is that it shows that the possible impact to household welfare and poverty would not have been large if the price of glutinous rice had been much higher than was observed in 2008. The dependency on the market in Laos is still low on average, so an impact from the outside shock can be absorbed by consumption from internal production. As seen above, the changes in household welfare for the entire Lao households are neutral, but are positive in rural areas to a price change of glutinous rice, but are negative in urban areas. The sizes of the negative welfare change for urban households do not change very much by expenditure quintiles and regions, but the size of the positive welfare increases in rural areas are concentrated in Vientiane and the Central region with more wealthy households. The resulting



increase in the poverty rates with a high price growth rate of glutinous rice (a 40 percent) is less than about 0.5 percent except for Vientiane, where the poverty rates increase by 0.7 percentage points in urban areas and decrease by 1.0 percentage points in rural areas. These sizes of the changes in the poverty rates are close to those in the studies in Vietnam and Cambodia, although the sizes of the welfare changes are smaller in Laos.

As seen above, the role of ordinary rice is much smaller than that of glutinous rice in Laos. Since the price of ordinary rice in Laos is much more likely to be affected by the international rice market than that of glutinous rice, the impact of a global food price crisis such as that in 2008 and price shock from outside is likely to be small. Rather, households in Laos are more likely to be impacted by the price of glutinous rice which is more affected by domestic factors such as the success or failure of rice production. This prevents Laos from being affected too much by possibly highly fluctuating rice prices in the world rice market. If moderately high and stable rice prices help induce more investment in more efficient rice cropping technology like HYV seeds and irrigation in Laos, they are not an issue for concern (Timmer, 2010). However, at the same time, the rice market in Laos can be isolated, and cannot profit from external demand.

The estimated impacts on household welfare and poverty are due to price increases which are not based on domestic supply or demand but are based on external shock. To analyze the impacts due to the price change which occurs because of domestic factors such as success or failure of rice production, a different approach is necessary. The change in rice production and resulting change in consumption is not assumed in this analysis, but a more complicated model such as the CGE model is necessary. GIEWS (2011) reported that Laos experienced a severe rice price increase in 2010 when glutinous rice price nearly doubled (but this extreme increase is

mainly due to low rice production because of a slow beginning of the rainy season in the year).  
But analysis of the impacts due to such internally induced price changes is beyond the scope of the analytical methodology in this paper.

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## Tables and Figures

**Table 1: Yearly Rate of Price Growth 2006-2008**

	North		Central		South		All			
	GL	OR	GL	OR	GL	OR	GL	OR	Food	Non-food
2006	0.273	0.084	0.284	-0.011	0.218	0.016	0.268	0.014	0.089	0.045
2007	0.071	-0.010	0.208	0.049	0.227	0.174	0.186	0.070	0.077	0.015
2008	0.078	0.059	0.121	0.293	0.059	0.203	0.101	0.229	0.105	0.043

Note: GL: Glutinous rice. OR: Ordinary rice. The 12-month growth rates for each month were calculated, and the means of the 12-month growth rates are taken within each year.

**Table 2: Percentage Change of PPI with One Percent Change in CPI and the Estimated PPI in 2008**

	CPI (2008)		Elasticity of PPI with respect to CPI		Estimated PPI (2008)	
	Glutinous	Ordinary	Glutinous	Ordinary	Glutinous	Ordinary
Vientiane-urban	0.121	0.293	0.97	1.37	0.117	0.402
Vientiane-rural w/ road	0.121	0.293	0.95	1.37	0.115	0.400
North-urban	0.078	0.059	1.26	1.40	0.098	0.082
North-rural w/ road	0.078	0.059	1.25	1.46	0.097	0.086
North-rural w/o road	0.078	0.059	1.05	1.23	0.081	0.072
Central-urban	0.121	0.293	0.97	1.28	0.118	0.374
Central-rural w/ road	0.121	0.293	0.95	1.23	0.114	0.361
Central-rural w/o road	0.121	0.293	0.85	1.27	0.103	0.372
South-urban	0.059	0.203	1.09	1.47	0.065	0.298
South-rural w/ road	0.059	0.203	1.08	1.55	0.064	0.314
South-rural w/o road	0.059	0.203	1.11	1.64	0.066	0.332
All	0.101	0.229	1.06	1.38	0.107	0.315

Note: CPI(2008) is take from Table 3.1. Elasticity of PPI is calculated following the formula in Section 3.2 using LECS4 data. Estimated PPI is calculated by multiplying the second column by the third column.

**Table 3: Sample, Poverty, Expenditures and Agricultural Producers in Laos**

	Sample HH size	HH size	Poverty rates	Food share	Share of farmer (producer)
All	8,296	6.53	0.276	0.723	0.879
Urban	2,064	6.10	0.174	0.654	0.633
Rural w/ road	5,135	6.68	0.299	0.747	0.975
Rural no road	1,097	6.90	0.426	0.775	0.999
Vientiane	768	5.77	0.152	0.632	0.473
North	3,136	6.85	0.325	0.734	0.960
Central	2,688	6.46	0.298	0.740	0.907
South	1,704	6.60	0.228	0.726	0.929
Vientiane-urban	528	5.92	0.153	0.619	0.304
Vientiane-rural w/ road	240	5.48	0.152	0.658	0.797
North-urban	592	6.06	0.146	0.651	0.828
North-rural w/ road	1,936	6.99	0.333	0.744	0.986
North-rural w/o road	608	7.16	0.495	0.786	1.000
Central-urban	624	6.26	0.222	0.675	0.735
Central-rural w/ road	1,856	6.52	0.317	0.766	0.988
Central-rural w/o road	208	7.00	0.547	0.829	1.000
South-urban	320	6.05	0.113	0.665	0.675
South-rural w/ road	1,103	6.80	0.260	0.745	0.988
South-rural w/o road	281	6.38	0.232	0.720	0.996
Exp. Quintile 1 (Lowest)	1,635	8.12	0.997	0.852	0.971
Exp. Quintile 2	1,621	7.05	0.372	0.795	0.935
Exp. Quintile 3	1,633	6.32	0.009	0.747	0.919
Exp. Quintile 4	1,698	5.87	0.000	0.686	0.840
Exp. Quintile 5 (Highest)	1,709	5.31	0.000	0.534	0.728



**Table 4: Yearly Glutinous Rice Production, Consumption, Sales and Purchases, by Household Groups**

	Consumption share in food	Purchase in consumption	Share of production	sales	Food purchase	Value produced	Value consumed
<b>Glutinous Rice</b>							
National	0.379	0.216	0.472	747	784	4,600	4,428
Urban	0.277	0.491	0.484	421	1,438	3,101	3,658
Rural w/ road	0.422	0.111	0.480	930	552	5,397	4,868
Rural no road	0.405	0.070	0.407	566	321	4,042	3,951
Vientiane	0.219	0.559	0.596	1,515	1,154	3,949	2,794
North	0.396	0.125	0.409	510	488	3,947	4,202
Central	0.395	0.197	0.523	746	809	5,388	4,894
South	0.413	0.213	0.453	689	1,000	4,618	4,882
Vientiane, urban	0.164	0.748	0.488	355	1,418	1,391	2,203
Vientiane, rural	0.324	0.245	0.674	3,739	649	8,848	3,926
North, urban	0.355	0.312	0.434	543	906	3,329	4,163
North, rural	0.405	0.079	0.404	502	395	4,084	4,211
Central, urban	0.306	0.418	0.526	383	1,572	4,100	4,278
Central, rural	0.437	0.091	0.522	919	446	6,001	5,187
South, urban	0.292	0.558	0.437	477	1,872	3,126	3,884
South, rural	0.442	0.131	0.456	739	794	4,970	5,117

Note: The units of the numbers in columns 2 to 4 are the percentages, and in columns 5 to 8 are thousand kips.

**Table 5: Yearly Ordinary Rice Production, Consumption, Sales and Purchases, by Household Groups**

Ordinary Rice	Consumption share in food	Purchase in consumption	Share of production	sale	Food purchase	Value produced	Value consumed
All	0.063	0.419	0.071	115	103	708	742
Urban	0.022	0.848	0.031	97	229	248	305
Rural w/ road	0.075	0.209	0.078	130	59	872	894
Rural no road	0.107	0.053	0.105	77	11	1,032	1,069
Vientiane	0.023	0.867	0.066	213	256	527	306
North	0.106	0.210	0.106	117	99	1,033	1,260
Central	0.049	0.435	0.059	103	68	686	554
South	0.043	0.397	0.039	79	86	340	498
Vientiane, urban	0.025	0.954	0.062	77	347	242	354
Vientiane, rural	0.019	0.580	0.068	473	81	1,072	215
North, urban	0.024	0.724	0.028	211	187	294	358
North, rural	0.124	0.120	0.120	96	80	1,197	1,461
Central, urban	0.016	0.835	0.022	64	159	229	229
Central, rural	0.065	0.168	0.073	122	24	903	709
South, urban	0.031	0.742	0.039	59	266	246	354
South, rural	0.046	0.246	0.038	83	44	363	532

Note: The units of the numbers in columns 2 to 4 are the percentages, and in columns 5 to 8 are thousand kips.

**Table 6: Percentage Change in Household Welfare and Point Change in Poverty Impacts due to Simulated 20 and 40 Percent Rice Price Increases with Estimated PPI ( $\neq$ CPI)**

Scenario	(1)				(2)			
	20				40			
	Estimated PPI		Estimated PPI		Estimated PPI		Estimated PPI	
Rice	Glutinous	Ordinary	Glutinous	Ordinary	Glutinous	Ordinary	Glutinous	Ordinary
	WF	Pov	WF	Pov	WF	Pov	WF	Pov
<b>All</b>	0.2	0.3	0.1	0.0	0.3	0.3	0.1	0.0
Urban	-0.8	0.5	-0.1	0.0	-1.5	0.5	-0.1	0.0
Rural w/ road	0.5	0.4	0.1	0.0	1.1	0.3	0.3	0.0
Rural no road	0.4	-0.5	0.1	0.0	0.8	-0.5	0.2	0.0
Quintile1-urban	-0.7		-0.1		-1.4		-0.2	
Quintile2-urban	-0.6		-0.1		-1.2		-0.1	
Quintile3-urban	-0.8		-0.1		-1.6		-0.2	
Quintile4-urban	-0.8		0.0		-1.6		-0.1	
Quintile5-urban	-0.8		-0.1		-1.7		-0.2	
Quintile1-rural	0.2		0.0		0.4		0.1	
Quintile2-rural	0.2		0.1		0.4		0.2	
Quintile3-rural	0.6		0.2		1.3		0.3	
Quintile4-rural	1.0		0.2		1.9		0.4	
Quintile5-rural	0.6		0.2		1.3		0.3	
Non-poor	0.2		0.1		0.4		0.2	
Poor	0.0		0.0		0.0		0.0	
Urban non-poor	-0.7		0.0		-1.4		-0.1	
Urban poor	-1.0		-0.2		-2.0		-0.4	
Rural non-poor	0.7		0.2		1.3		0.3	
Rural poor	0.2		0.1		0.4		0.1	
Vientiane, urban	-0.9	0.7	-0.2	0.0	-1.8	0.7	-0.4	0.0
Vientiane, rural	2.5	-1.0	0.5	0.0	5.0	-1.0	1.0	0.0
North, urban	0.0	0.4	0.1	0.0	0.1	0.4	0.2	0.0
North, rural	0.4	0.3	0.1	0.1	0.9	0.2	0.2	0.0
Central, urban	-0.9	0.4	-0.1	0.0	-1.8	0.4	-0.1	0.0
Central, rural	0.5	0.3	0.1	0.0	1.0	0.3	0.3	0.0
South, urban	-1.2	0.3	-0.2	0.1	-2.4	0.3	-0.3	0.1
South, rural	0.2	0.5	0.1	0.0	0.5	0.5	0.2	0.0

Note: WF: Percent change in household welfare (-B), Pov: Percentage point change in the poverty headcount ratio

**Table 7: Fractions of Net Sellers and Net buyers**

Rice	Glutinous		Ordinary	
	NS	NB	NS	NB
National	0.23	0.23	0.05	0.12
Urban	0.14	0.48	0.03	0.29
Rural w/ road	0.27	0.14	0.05	0.06
Rural no road	0.29	0.09	0.08	0.02
Q1-urban	0.12	0.40	0.04	0.17
Q2-urban	0.21	0.38	0.04	0.22
Q3-urban	0.16	0.48	0.03	0.32
Q4-urban	0.14	0.50	0.03	0.30
Q5-urban	0.08	0.62	0.04	0.44
Q1-rural	0.17	0.10	0.04	0.04
Q2-rural	0.22	0.12	0.04	0.03
Q3-rural	0.28	0.13	0.05	0.04
Q4-rural	0.33	0.13	0.06	0.05
Q5-rural	0.35	0.18	0.07	0.09
Non-poor	0.26	0.26	0.05	0.14
Poor	0.17	0.16	0.04	0.06
Urban non-poor	0.15	0.49	0.04	0.31
Urban poor	0.10	0.42	0.02	0.17
Rural non-poor	0.31	0.14	0.06	0.06
Rural poor	0.18	0.10	0.04	0.03
Vientiane, urban	0.09	0.59	0.03	0.46
Vientiane, rural	0.47	0.22	0.11	0.16
North, urban	0.15	0.37	0.02	0.19
North, rural	0.21	0.12	0.06	0.05
Central, urban	0.15	0.43	0.03	0.24
Central, rural	0.28	0.11	0.05	0.04
South, urban	0.20	0.54	0.07	0.26
South, rural	0.30	0.16	0.04	0.05

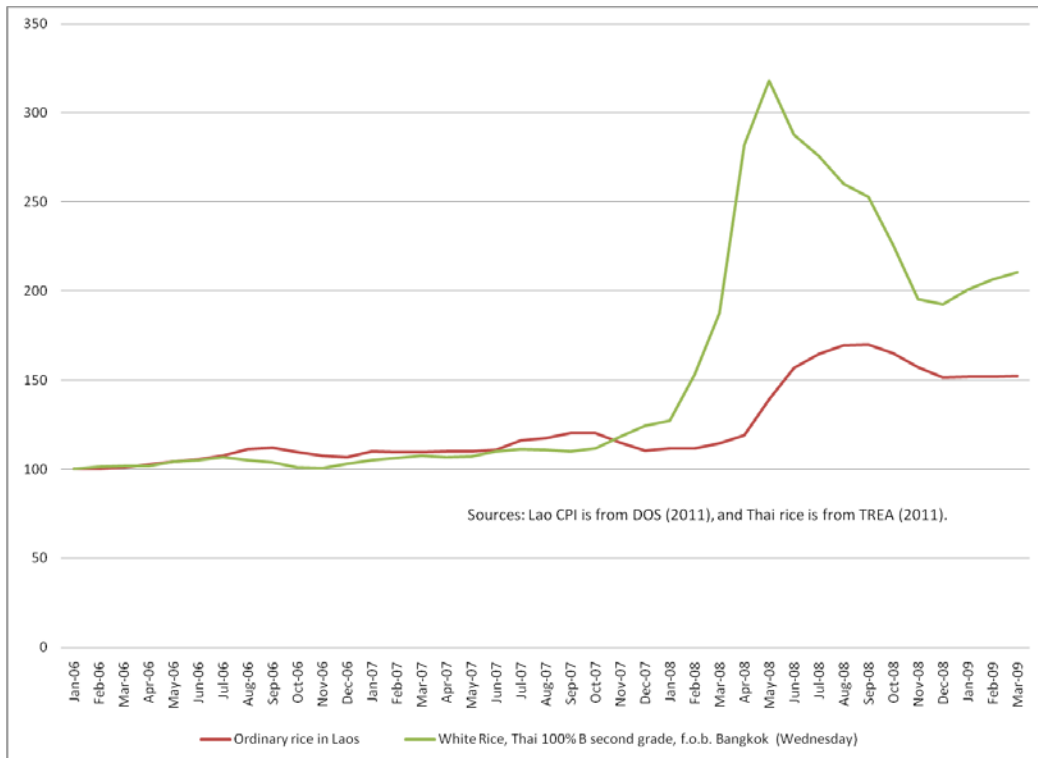
Note: NS: Net sellers, NB: Net buyers.

**Table 8: Impact of Rice Price Increases in 2008 in Laos with Estimated PPI (≠CPI)**

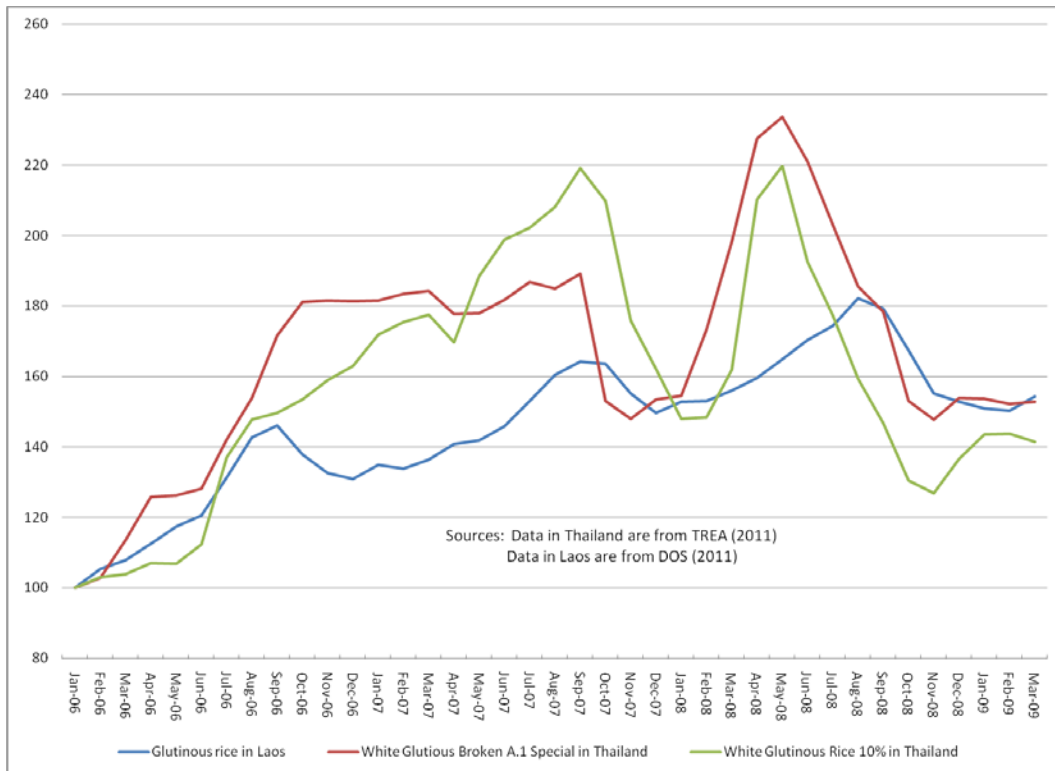
	Glutinous Rice			Ordinary Rice			Rice		
	WF	Ch. Pov.	Pov.	WF	Ch. Pov.	Pov.	WF	Ch. Pov	Pov
National	0.0	0.0	27.6	0.0	0.0	27.6	0.0	0.0	27.6
Urban	-0.5	0.2	17.6	-0.1	0.0	17.4	-0.6	0.3	17.7
Rural w/ road	0.2	0.0	29.9	0.0	0.0	29.9	0.3	-0.1	29.9
Rural no road	0.2	-0.4	42.2	0.2	0.0	42.6	0.4	-0.4	42.2
Quintile1-urban	-0.4			-0.1			-0.6		
Quintile2-urban	-0.4			-0.1			-0.4		
Quintile3-urban	-0.5			-0.1			-0.6		
Quintile4-urban	-0.5			-0.1			-0.6		
Quintile5-urban	-0.5			-0.1			-0.6		
Quintile1-rural	0.1			0.0			0.1		
Quintile2-rural	0.1			0.1			0.1		
Quintile3-rural	0.3			0.1			0.4		
Quintile4-rural	0.4			0.1			0.4		
Quintile5-rural	0.3			0.1			0.3		
Non-poor	0.1			0.0			0.1		
Poor	0.0			0.0			-0.1		
Urban non-poor	-0.4			-0.1			-0.5		
Urban poor	-0.6			-0.3			-0.9		
Rural non-poor	0.3			0.1			0.3		
Rural poor	0.1			0.0			0.1		
Vientiane, urban	-0.5	0.4	15.7	-0.3	0.0	15.3	-0.8	0.7	16.0
Vientiane, rural	1.0	-0.4	14.7	0.1	0.0	15.2	1.1	-0.4	14.7
North, urban	0.0	0.3	14.9	0.2	0.1	14.7	0.2	0.3	14.9
North, rural	0.2	0.0	36.5	0.1	0.0	36.5	0.2	0.0	36.5
Central, urban	-0.5	0.4	22.6	-0.1	0.0	22.2	-0.6	0.4	22.6
Central, rural	0.2	-0.1	33.3	0.0	-0.1	33.4	0.2	-0.2	33.3
South, urban	-0.7	-0.6	10.7	-0.2	0.1	11.4	-1.0	-0.6	10.8
South, rural	0.1	-0.1	25.4	0.0	0.0	25.5	0.2	-0.1	25.4

Note: WF: The percent change of household welfare (-Bi), Ch. Pov.=Percentage point change of poverty rates, Pov. = new poverty rates.

**Figure 1: Evolution of International and Domestic Ordinary (Non-glutinous) Rice in Laos, January 2006 to March 2009 (January 2006=100)**



**Figure 2: Evolution of International (Thai Export Price) and Domestic Glutinous Rice in Laos, January 2006 to March 2009 (January 2006=100)**



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## Notes

<sup>1</sup> The map of four regions is shown in Figure 3.2 in Takamatsu (2011). Laos' 17 provinces can be aggregated into one province (Vientiane) and three regions (North, Central and South).

<sup>2</sup> The slower growth rate in the price of glutinous rice in 2008 is considered to be due to supply-side factors. The most direct evidence to support this hypothesis is that the per capita production was much higher in 2008 (and 2009) than in 2006 and 2007 (445 kg/person in 2006 and 2007, 477 and 498 kg/person in 2008 and 2009, respectively). The growth rates of per capita production were 1.9, -0.1, 5.9 and 5.3 percent in 2006 to 2009, respectively. (See FAO (2010) for production, World Bank (2010) for population). Evidence to support the hypothesis that the slower price growth rate in 2008 is due to demand-side factors cannot be found in literature.

<sup>3</sup> Monthly farm-gate price data are available from the Ministry of Industry and Commerce, but this survey is not nationally representative, and those data are not used in this study.

<sup>4</sup> For some districts in the North region, the distance to Hanoi in Vietnam and southern large cities in China is less than that to the Vientiane.

<sup>5</sup> One possible source is the elasticities of demand used in the GTAP database (Badri and Walmsley 2008), but the quality of these numbers is unclear, and so was not used in this study.

<sup>6</sup> The data do not allow one to identify missing seasons since the questionnaire asked only the usage of crops including sales in the last season and did not record the season. The most ideal remedy to this issue is the use of seasonal weights which reflect the difference of the sales values between the two seasons rather than simply doubling the sales in one season. But the data do not allow one to do this.

<sup>7</sup> The numbers in the table exclude agricultural wage labor, but the LECS data also show that 76.9 percent of persons who worked last seven days engaged in agricultural activities.

<sup>8</sup> Since the food consumption in total expenditures is 72.3 percent, this number also indicates the importance of glutinous rice in entire expenditures.

<sup>9</sup> The table with the assumption that the CPI = PPI is not shown for brevity since the difference in the numbers is negligible. The table with the assumption is found in Table 3.9 in Takamatsu (2011).