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Global market shocks and poverty in Vietnam: the case of rice

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Abstract

World food prices have experienced dramatic increases in recent years. These "shocks" affect food importers and exporters alike. Vietnam is a major exporter of rice, and rice is also a key item in domestic production, employment and consumption. Accordingly, rice price shocks from the world market have general equilibrium impacts and as such, their implications for household welfare are not known *ex ante*. In this paper we present a framework for understanding the direct and indirect welfare effects of a global market shock of this kind. We quantify transmission of the shock from global indicator prices to domestic markets. Then we use an applied general equilibrium model to simulate the economic effects of the price changes. A recursive mapping to a nationally representative household living standards survey permits us to identify in detail the *ceteris paribus* effects of the shock on household incomes and welfare. In this analysis, interregional and intersectoral labor market adjustments emerge as key channels transmitting the effects of global price shocks across sectors and among households.

Keywords: Vietnam, rice, poverty, labor mobility, general equilibrium, microsimulation

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1. Introduction

Vietnam is a net food exporter, so it is reasonable to expect that rising global rice prices increase aggregate income. However, the majority of Vietnamese are net consumers of rice, even within the rural economy. Moreover, with more than half the population earning less than $2/day, vulnerability even to a small downturn in purchasing power is very high. Thus for specific segments of the population both poverty and food insecurity are likely to be made worse, at least temporarily, by higher rice prices.

Assessing the effects on poverty of a large change in global rice prices is complicated by several factors. First, the impact of global shocks on the domestic economy depends on price transmission, which is imperfect even for a crop as widely traded as rice, and on supply response, which is constrained by availability of land and other inputs. Second, there are multiple channels through which rice prices affect household welfare, beyond their direct effects on farm incomes and consumer prices. Most importantly, their influence on factor prices cannot be discounted, since rice is a major employer of rural labor and agricultural land. In addition, many food-processing industries use rice or its substitutes as inputs, and their prices and profitability may also be affected. Finally, because rice is a major export it is possible that profitability in some industries is impacted by adjustment to a new international trade equilibrium. To capture these economy-wide effects requires a general equilibrium approach.

In Vietnam, rice is the staple food of virtually all households and contributes two-thirds of daily calorie intake. Rice prices influence the prices of a broad array of foodstuffs. In addition, the rice crop is by far the most important source of agricultural income. This sector directly employs half the labor force—and, of course, a far higher percentage of labor that is classified as low skill, and therefore poorly paid. Rice production accounts for nearly 60% of cropland and the majority of farm employment. Rural poverty accounts for 85% of total poverty in Vietnam (Table 1), and in the 2006 Vietnam Household Living Standards Survey (VHLSS), four-fifths of poor households were identified as rice-growers (Linh and Glewwe 2011, Table 1). Even though food accounted for half of households' real expenditure (the figure ranges from 65% in the poorest quintile to 37% in the richest), the mean household in every quintile of the income distribution was a net rice seller. However, the distribution is highly skewed: by value, 33% of all rice produced comes from just 5% of farmers, nearly all of them in the nation's largest rice-growing region, the Mekong Delta.

In the wake of the 2007-08 global food price surge, numerous studies have been conducted to assess its welfare impacts in low-income countries.[1] For the most part they do this under partial equilibrium

assumptions, showing how the total expenditures of households would be altered by a change in food prices, holding constant the all other sources of possible change such as land use, labor market adjustments and policy responses. In Vietnam, for example, Linh and Glewwe found that for a 10% rise in food (rice) price, aggregate welfare rises by 1.17% (0.63%), and poverty falls by 0.59% (0.10%). Using price changes observed in 2007, they calculated that food price increases caused aggregate welfare to rise by 4.3 percent and poverty to fall by 1.3%. Observed rice price increases had smaller effects, raising welfare by 1.1% and reducing poverty by 0.2%. Of course, these gains were not evenly distributed; in fact, Linh and Glewwe concluded that direct impacts of higher food or rice prices were to make *the majority* of households worse off in both urban and rural areas, in all regions, and in all quintiles of the income distribution. This assessment (and others like it, for example Jensen and Miller 2008; Haq et al. 2008; Zezza et al. 2008; Aksoy and Isik-Dikmelik 2008) draws attention to household heterogeneity, but leaves important questions unanswered. Specifically, what characteristics of households are associated with a propensity to gain or to lose from a food price shock? And how does economy-wide adjustment affect household welfare?

A few other studies have taken account of general equilibrium impacts (Ivanic and Martin 2008; Warr 2008; Kompas et al. 2010). Warr's Thailand study is an important comparison. Like Vietnam, Thailand is a net rice exporter, so the aggregate welfare impact of a price rise is positive. But as in Vietnam, the majority of Thailand's population are net rice consumers, so the shock has potential to increase poverty for some groups. Warr finds that only those households whose income derives in large part from land experience lower poverty. Higher rice prices do raise demand and wages for unskilled workers, but this gain is insufficient to offset their losses as consumers. In Vietnam however, agriculture (and specifically rice) accounts for a much larger share of total economic activity and employment than in Thailand. There are other differences between the two countries; notably, market-driven development is a much newer phenomenon in Vietnam, so the efficient operation of product and factor markets (as assumed in the Thailand study) might face impediments in Vietnam's case. Moreover, Vietnam's policy response to the rise price surge included a brief ban on the signing of new export contracts (from March to May 2008), which by limiting domestic price increases, may have provided some regions and some poor households with a temporary shield against the full impact of the global price shock (Kompas et al. 2010).

In this paper we use general equilibrium methods to shed light on why some households gain while others lose from a shock, and to ask whether findings based only on net food or rice consumption data remain robust when related adjustments in other markets and in the macroeconomy are taken into account. In section 2 we present some simple theory to identify the most important sets of such influences. In section 3 we consider the nature and magnitudes of actual shocks, adjusting for incomplete transmission from global prices to domestic markets. In section 4 we introduce a general equilibrium model of the Vietnamese economy, which we then use to simulate the effects of a global

rice price shock. The model and experiments take account of possible impediments to the efficient operation of the all-important labor market. In section 5 we compute the effects of the shock on poverty and welfare by mapping the results onto a national household data set. Section 6 concludes and points out paths for future research.

2. Analytical framework

2.1. Sources of household welfare change

Imagine an economy that consists of farm (f) and non-farm (n) sectors, which are also spatially separate (i.e., rural and urban). For heuristic purposes, just one good is produced in each sector: food (rural) and non-food (urban). Each agent (household) has an endowment of land $T \geq 0$ and labor $L \geq 0$. Land is used for food production together with farm labor L_f, which can be hired in at wage w_f or supplied by the household. Household labor can also be hired out to other farms at wage w_f, or to a non-farm labor market paying w_n. There is no market for land. Farm output can be consumed at home or sold at market price p_f. Again for simplicity, we assume that this price applies to producers and consumers alike.

Given a concave agricultural production function, each agent for which $T > 0$ maximizes the returns to land, resulting in a profit function $\pi(p_f, w_f, T)$. The model is thus recursive as in Singh, Squires and Strauss (1986) and Deaton (1989). Labor hours not used on the family farm are hired out, or can be consumed as leisure, along with other goods (food and non-food) that are purchased in the market. These conditions result in an endowment budget constraint of the form

$$y = p_f \cdot c_f + p_n \cdot c_n = w_f \cdot L_f + w_n \cdot L_n + \pi(p_f, w_f, T) + b, \tag{1}$$

where b represents unearned income from distributed corporate profits, remittances, and transfers. Each household's preferences over consumption of goods and labor supplied to each labor market is given by a quasiconcave utility function of the form

$$u = u(c, -L) = u(c_f, c_n, -L_f, -L_n). \tag{2}$$

Leisure is a normal good and we assume non-satiation in consumption, so a positive amount of leisure is always consumed and thus the total labor constraint $(L - L_f - L_n)$ never binds.

We seek a measure of the change in consumer welfare, and of labor allocation to different activities, associated with some exogenous shock such as a change in the price of food. The household's problem is to choose values of $(c, -L)$ so as to minimize expenditures subject to target utility, that is:

$$L = (p_f \cdot c_f + p_n \cdot c_n - w_f \cdot L_f - w_n \cdot L_n - \pi(p_f, w_f, T) - b) + \lambda[u - u(c_f, c_n, -L_f, -L_n)].$$

This gives a set of first-order conditions

$$p_i - \lambda \frac{\partial u}{\partial c_i} = 0$$

$$-w_j + \lambda \frac{\partial u}{\partial L_j} = 0 \qquad \text{for i,j = f,n} \tag{3}$$

as well as the recovered constraint (2). From these we obtain the compensated commodity demand and labor supply functions

$$c_i(p,w,b,u) \qquad \text{and} \qquad -L_i^S(p,w,b,T,u), \qquad i = f,n \tag{4}$$

where the superscript S will serve to distinguish labor supply from demand in subsequent expressions.

The preference structure in (2) allows for a different disutility of labor supply (that is, reservation wage) in each labor market (Lopéz 1986). Within the farm sector, concavity of the agricultural production function means that households with land allocate their labor to own-farm operations up to the point where the disutility-adjusted value marginal product of labor supplied to the farm and to the wage labor market is equal (Sumner 1982). Beyond that point, additional hours worked are supplied to the market offering the highest disutility-adjusted wages.

Substituting expressions (4) back into the objective function (1) gives the expenditure function

$$e(p,w,T,b,u) = \Sigma_i p_i c_i(p,w,b,u) - \Sigma_i w_i L_i^S(p,w,b,T,u) - \pi(p_f,w_f,T) - b, \tag{5}$$

which is the minimum *lump-sum* expenditure required to achieve a target level of utility, given prices (p,w) and exogenous endowments (L_i^S,b,T) (Dixit and Norman 1980). This provides a money metric of household welfare.

2.2. Comparative statics: food price rise

The equivalent variation of a change in all prices and wages (holding the land endowment fixed) is found by taking the total derivative of (5), using the envelope theorem. The direct effect is on food expenditures and food producer incomes, but in addition, non-food prices and wages may also change as the result of general equilibrium adjustments. In a heavily agrarian economy, the most obvious indirect influence of food prices is on the farm wage, where $\partial w_f/\partial p_f > 0$ follows from the fact that land is fixed in quantity; higher food prices raise the value marginal product of farm labor. The price of non-food consumer goods may also respond to the rising food price, through substitution in consumption, through competition in factor markets, or through macroeconomic channels such as the trade accounts. Therefore, $\partial p_n/\partial p_f \neq 0$. Finally, the change in food prices might affect demand for non-farm labor, causing $\partial w_n/\partial p_f \neq 0$. This could occur even if the farm and non-farm labor markets are segmented: for example, if a rise in the food price reduces profitability in industries (such as food

processing and fish-farming) where food or feed is an important component of production costs. If those industries are constrained by global markets from raising their own output prices, their labor demand will fall and this will have an impact on aggregate non-farm wages. Finally, transfer income b might also change, for example due to endogenous changes in remittances or enterprise profits.

Noting (by Shephard's lemma) that $\partial\pi/\partial p_f = q_f$ is own production of food and $\partial\pi/\partial w_f = -L_f^D$ is farm labor demand, the total derivative of (5) can then be written:[2]

$$de(p,w,b,T,u) = (c_f - q_f)dp_f + c_n dp_n - (L_f^S - L_f^D)dw_f - L_n^S dw_n - db. \quad (6)$$

The left side of (6) measures equivalent variation, that is, the net lump-sum payment required to maintain initial utility given a change in (p, w, b). For ease of interpretation, multiply (6) by –1 and normalize by initial income (y). On the right hand side, multiply and divide each term by the relevant price or value to obtain proportional changes (that is, growth rates) where $\hat{p}_i = dp_i/p_i$ and $\hat{w}_i = dw_i/w_i$ for i = f,n, and $\hat{b} = db/b$. Then write V(p,w,T,u) = –de(p,w,T,u)/y to denote the money value of a welfare gain expressed as a fraction of base income (y):

$$V(p,w,b,T,u) = -\frac{p_f(c_f - q_f)}{y}\hat{p}_f - \frac{p_n c_n}{y}\hat{p}_n + \frac{w_f(L_f^S - L_f^D)}{y}\hat{w}_f + \frac{w_n L_n^S}{y}\hat{w}_n + \frac{b}{y}\hat{b} \quad (7)$$

The expression for V(.) is linear in each price change, so their effects can be considered separately. The first term confirms the familiar result that any household that is a net consumer of food ($c_f - q_f > 0$) experiences a direct welfare loss from the food price rise, as in Deaton 1989. This component of welfare change is greater, the larger is $|c_f - q_f|/y$, so heterogeneity in food expenditure shares and in shares of income from food production is potentially important in explaining divergent household welfare outcomes. The second and subsequent terms in (7) capture indirect effects due to endogenous changes in other prices. If non-food consumer prices rise due to the food price shock, then the second term shows that households with a large budget share of non-food items experience a greater welfare loss. In the third term, higher food prices raise the marginal value product of farm labor, and this is reflected in a higher nominal farm wage. Households who are net sellers of farm labor ($L_f^S - L_f^D > 0$) experience a gain, whereas net purchasers of farm labor see their gains as food producers offset somewhat by higher costs when farm wages rise. Again, this effect is greater for households with high net sales of labor relative to income, i.e. those for which $|L_f^S - L_f^D|/y$ is large. Finally, any change in non-farm wages lowers or raises the incomes of households supplying labor to this market, by an amount scaled by the initial share of non-farm earnings in total income, $w_n L_n^S/y$.

Quantitative analyses of food price shocks based only on household survey data often calculate only the direct impact shown in the first term of (7). The expression shows, however, that there is substantial ambiguity in the welfare impact of a food price shock when responses in other markets are

taken into account. In particular, net food consumers in rural areas are typically also net suppliers of farm labor, while farmers with larger plots are net labor buyers. For the latter, the sign of the third RHS term in (7) is opposed to that of the first. Predictions of the effects of a food price change that ignore farm wage changes will tend to overstate the gains of farmers and the losses of laborers.

How important are the indirect components of real income change likely to be? In low-income economies, food is the largest single item in consumer expenditures. Agriculture is typically the largest single employer, and food crops are the largest agricultural employers. With land in inelastic supply, higher food prices must raise the marginal value product of farm labor. If there is an active labor market then wages will rise; if not, the opportunity cost of off-farm or non-farm employment – that is, the supply price of wage labor – will rise. Rearranging (7),

$$V(p,w,b,T,u) = -\sum_i \gamma_i \hat{p}_i + \sum_j \eta_j \hat{w}_j + \kappa \hat{r} + \varphi \hat{b}, \qquad i,j = f,n \tag{8}$$

where $\gamma_i = p_i c_i / y$ are expenditure shares, $\eta_j = w_j L_j^S / y$ are labor income shares, $\kappa = r_f T / y$ is the share of income from land with unit land return r_f,[3] and $\varphi = b/y$ is the income share of transfers. The first term is the change in a household-specific consumer price index of the form $CPI = \Pi_i p_i^{\gamma_i}$. The other terms are income-share weighted changes in household income due to changes in wages, land returns, and transfers.

For Vietnam, Table 2 summarizes income and expenditure shares corresponding to those in equation (8). Earnings from capital ownership and from public and private transfers are shown as separate items. The data in this table underline the relative importance of food expenditures and labor income in household accounts. They also illustrate the diversity of household incomes and expenditures, especially between urban and rural regions.

We can also define changes in household poverty by comparing changes in real household income in (8) to a real (inflation-adjusted) poverty line, z. Consider the generalized poverty measure due to Foster et al. 1984, which is parametric in a measure $\alpha \geq 0$ of aversion to inequality among the poor, and which includes as special cases the headcount ratio ($\alpha = 0$) and the average poverty gap ($\alpha = 1$):

$$POV_\alpha = \frac{1}{nz} \sum_h g_h^\alpha, \text{ where } g_h = \left(z - y_h\right) \tag{9}$$

for all poor households h in a population of size n. Poverty thus changes when determinants of y_h change (Coxhead and Warr 1995). This poverty measure can also be computed for population subgroups, whether by function (net producers, net consumers, etc.), by region, or by some other characteristic.

We are interested in the welfare and poverty outcomes of an economy-wide shock originating in the global food market. In Vietnam, the relevant price is that of rice, since this by far the most important component in that country's food production, consumption and trade accounts. A rice price shock is captured directly in the foregoing model by the change in p_f, and indirectly by induced changes in other prices and incomes. Two empirical questions thus arise concerning the effects of a global market shock: how large a change does it induce in domestic rice and paddy (rough rice) prices, and how do these changes affect other prices and incomes? In the next section, we resolve the first question by examining the transmission of the 2008 global rice price rise to domestic Vietnamese markets. Subsequently we use our estimate of this price change to drive a numerical general equilibrium simulation in which all domestic prices and incomes are endogenous.

3. Prices and price transmission

In the first and second quarters of 2008, world benchmark rice prices rose very sharply, peaking at an increase of over 250% year-on-year. Figure 1 shows that international prices received by exporters of Vietnamese rice had previously tracked benchmark price changes closely, remaining very close to their long-run average of 93% of the relevant Bangkok fob price (5% broken).

In the domestic market, retail and farm gate prices both rose along with the border price, but by much less. Figure 2 shows domestic and export prices, along with the margin between the two. From January-May 2008, the export price rose by 168% but the farm gate price by only 67%. Thus only a part of the global price shock was passed through to Vietnam's exporters, and a still smaller fraction was transmitted to domestic markets. Nevertheless, the shock they experienced was both real and significant. The average nominal retail price in 2008, 5,740 VND/kg, was nearly double that in 2006 (2,921 VND/kg) and remained at that level in the first half of 2009.

Vietnam's rice export trade is nominally open to all, but in practice it is dominated by two state-owned corporations, Vinafood I and Vinafood II. In 2008 these corporations accounted for 15% and 41% respectively of the country's total rice exports (Agroinfo 2009). Our main interest is in the extent of overall transmission from world to domestic prices. However, the two traders appear to behave somewhat independently, so it is possible that their actions could result in different regional price responses.[4]

Figure 4 shows the change in paddy prices compared to that in retail rice prices from 1/2007 to 1/2010. The price changes are very similar, suggesting that these markets are integrated. In the analysis that follows, we use only retail price data, because this series is more complete.

We use an econometric model to examine the pass-through effect of international prices to domestic prices. First, we estimate the following long-term relationship:

$$\ln p_{rt} = a_r + b_r \ln p_{Bt} + \varepsilon_{rt} \quad (10)$$

where t denotes time and r region (North, South) so p_{rt} is the market price in region r and time t; p_{Bt} is the f.o.b. export price in local currency terms; a_r and b_r are parameters to be estimated, and ε_{rt} are residuals. In this analysis, we use the prices of Vietnamese rice exports (5% broken) as a proxy for world prices. The data are monthly domestic rice prices and export prices from January 2001 to December 2009. We divide the series into two sub-periods: pre-crisis, from January 2001 to February 2007, and the crisis period from March 2007 (when for the first time, export rice prices rose above US$ 300 per ton) to December 2009.

Table 3 shows estimates of (10). For the whole period, the estimated pass-through elasticities are 0.857 in the North and 0.870 in the South. The estimates were lower in the pre-crisis period: 0.732 (North) and 0.724 (South). In the crisis period, the estimates were much lower at 0.608 and 0.603. Thus the rate of price transmission is similar in both major rice-producing regions and while high, is far short of unity—especially during the crisis.

An Augmented Dickey-Fuller (ADF) test on the univariate series in equation (10) indicates that the residuals are stationary and non-trending in both the whole time series and the pre-crisis period. However, the null hypothesis of a unit root could not be rejected for the crisis period. To capture cointegrating relationships, we use the Error Correction Model (ECM) (Engle and Granger 1987). We estimate the equation:

$$\Delta \ln p_{rt} = a_0 + b_1 \Delta \ln p_{Bt} + b_2 \left[\ln p_{rt-1} - \theta \ln p_{Bt-1} \right] + \varepsilon_t \qquad r = N,S, \quad (11)$$

in which Δ is a difference operator, i.e. $\Delta \ln p_{rt} = \ln p_{rt} - \ln p_{rt-1}$. The coefficient b_1 is the short-run elasticity; b_2 is the error correction coefficient, and θ is the long-run elasticity.

Table 4 shows estimates of (11). For the whole period, long-run pass-through elasticity estimates are high, at 0.927 (North) and 0.970 (South). In the crisis period, however, these are considerably lower at 0.774 and 0.745. As mentioned above, the Vietnamese government applied short-lived restrictions on the signing of new export contracts in the second quarter of 2008, and even though there was little effect on *annual* exports (which actually rose 3.6% over 2007[5]), the lower values may in part reflect this intervention.

Our intent is to simulate the effects of a *counterfactual* price shock—one that departs from underlying price trend and the effects (if any) of the threatened export ban. From the data, the average annual rise in f.o.b. price in 2001-2006 was 7.8% (North) and 7.6% (South). Using these rates, the counterfactual price rise can be computed. This calculation (in Appendix A) shows that the 2007-08

price rise was equivalent to a 35% increase in the domestic price relative to its underlying trend. This is the value of the price shock that we use in our general equilibrium experiments.

4. Empirics: effects of the shocks

4.1 General equilibrium perspectives

In this section we investigate the welfare effects of global rice price shocks in Vietnam, with the help of an applied general equilibrium (AGE) model. In an economy where rice is of such great importance, there are likely to be endogenous adjustments in economy-wide factor and product markets, as discussed in section 2. The AGE approach accounts for these. It also captures the main macroeconomic effects of any change in the country's fiscal accounts and external balance of payments.

At the most aggregate level, consider the macroeconomic effects of a boom in rice export earnings caused by the rise in world prices. For a given quantity of rice exported, and assuming no change in other trade magnitudes, the higher world price is the cause of a rise in net exports, one of the components of final demand. The effects of this rise depend on conditions in the domestic economy. If the economy was initially operating at capacity (full employment of factors), the rise in net exports opens an expansionary gap. In the absence of a policy response, this will raise aggregate income but also generate inflationary pressures. Higher prices for some goods will raise the value marginal products of factors used to produce them, and this will spill through factor markets to all other industries. Output prices must then rise to maintain zero pure profits, contributing to a general price inflation. On the other hand, if initially there is spare capacity (including unemployed or underemployed workers), then the rise in net exports may be met by mobilizing these resources to expand output in directly affected sectors, with diminished cost-push penalties on other industries. The key difference between these cases is that in the first, the rise in net export revenues causes output of some industries to go down and generates inflationary pressures, while in the second the growth in export demand is met at more or less constant prices and with no sacrifice of output in any sector. Aggregate welfare must rise in either case, but the distribution of gains and potential losses across industries and among the owners of labor, land and capital will differ.

In Vietnam, the most likely case is a mixed one, because low-skill labor is somewhat elastically supplied but other factors are not. There is abundant unemployed or underemployed rural labor (CIEM 2008; Coxhead et al. 2009; Manning 2009), but there is very little idle land suitable for farming.[6] Therefore, the macroeconomic response will depend on microeconomic factors, including firm and consumer responses and the extent and speed of adjustment in the markets for land and labor. In the short run, owners of the least elastically supplied factors employed in the rice sector (i.e., land and fixed capital) should benefit most from the windfall, with some additional gains going to workers

who are newly employed or enjoy increased working hours. The rise in land returns will reduce profits in industries that compete to use land for other purposes. Effects in other industries will in general depend on the extent to which rice sector supply response affects wages or the supply of low-skill labor, which the industry uses intensively.

Among households, the most obvious gainers will be those whose income depends heavily on land and rice sector capital, since these factor prices will rise by most. Owners of specific factors in sectors where profitability has been reduced will lose. Owners of factors (such as labor) that are mobile across many industries will gains in nominal returns, but whether these are sufficient to compensate for the increased cost of living is not known *a priori*. With food prices rising faster that the CPI, lower-income households whose share of food in total outlays is high will suffer a relatively larger cost of living increase.

4.2 The model

When assessing the links between macro or trade shocks and microeconomic outcomes, the difficulty of evaluating cause and effect is well known. For normative purposes it is important to have some idea of these links, in order to be able to assess the impacts of shocks on household welfare and design effective policy interventions. To do this rigorously requires a framework capable of characterizing growth or policy shocks, and tracing these in a consistent manner through markets and other economic channels down to sectoral, regional and household level.

AGE models represent the entire economy in numerical form. They combine baseline information from national accounts and other sources about the activities of firms, households, enterprises and government with theory-based specifications of firm and household behavior, market operation, labor, capital and resource supplies, trade balances and other constraints, and the assumed behavior of foreign agents who are the partners in trade and investment. They thus provide a consistent interface between macro and micro phenomena, at least in the realm of the real economy.

We use an AGE model of the Vietnamese economy to observe the effects of shocks on prices and the incomes of producers and consumers, and through their reactions to these changes, to trace effects on the markets for labor, land and capital, consumer choices, and other consequences. Because households have different patterns of asset ownership, income, and expenditure we can measure effects on poverty and income inequality. The model itself is based on a popular AGE template that provides for factor supply, production, domestic and international trade, and consumption, savings and investment by a variety of domestic agents and institutions (Löfgren et al., 2002). Our model (documented in greater detail in Coxhead et al. 2010) modifies this template in a variety of ways as described below. The core database is the 2003 Vietnam Social Accounting Matrix (SAM) (Jensen and Tarp 2007), which is the most recent such database that is publicly available. The SAM is

constructed from a variety of official sources, most prominently national supply-use tables, and the VHLSS. Our extrapolations from the model and database to household incomes and poverty draw again—and independently—from the 2004 VHLSS.

The model identifies 112 single-product industries and three aggregate primary factors: land, labor, and capital. Land is an input to production only in agriculture, and is of two types: paddy land and all other uses. Paddy land can be reallocated to other annual crops, but in practice these account only for a small acreage. All other land is specific to the crops grown on it—mainly perennials such as rubber, coffee, and tea. Although other AGE models permit land to be freely reallocated among crops, this restriction better reflects land use realities and in particular the overwhelming predominance of paddy production on irrigated land. An implication is that supply response to an increase in a single crop price is less elastic, since supply response is inversely proportional to the share of fixed factors in total costs.

Labor is a composite of twelve different types distinguished by gender, location (urban/rural), and skill (low/medium/high). These categories are based on aggregations in the 2003 SAM. Labor demands are derived in the usual way from profit-maximizing choices made by a representative firm in each industry. The model posits a nested factor demand structure, with composite factor demand decisions at the top level and demands for each type of labor determined at the next level. The aggregation of labor by type, and of factors into a primary factor composite, uses CES technology, as does the combination of the primary factor aggregate with intermediate inputs. Imports, including intermediates, are differentiated from domestically produced equivalents (the Armington assumption).

In order to conduct experiments we must make assumptions about labor supply, pricing, and mobility between locations. With little empirical research to guide us, we explore several alternatives, or closures:

> *Closure 1* assumes that labor of each type is fixed in total supply, so that an increase in demand for that type of labor by some industries must be matched by an equal reduction in other industries. In this closure we also assume that rural labor cannot move to urban areas, and vice versa. Closure 1 is based on rather restrictive assumptions relative to Vietnamese reality (Phan and Coxhead 2010).
>
> *Closure 2* retains the assumption of fixed total quantities of each type of labor, but permits interregional migration. If an urban-based industry (e.g., garments and textiles) seeks to expand, it can draw on workers of a given type (e.g., female, medium-skill) from either urban or rural regions. In equilibrium, wages for the same type of labor grow at the same rate in both regions. In this closure, migration in response to rising labor demand in specific industries provides an important channel to redistribute the gains of growth from one region to the other.

Closure 3 alters closure 2 by assuming that total supply of some types of labor is responsive to changes in wages. Job creation in one region or industry may draw in workers from others, but also stimulates an increase in total labor force participation or hours worked. Labor demand growth thus reduces unemployment and underemployment, which is quite high among unskilled workers but not, however, for skilled workers. Accordingly we posit different labor supply elasticities by the skill and location of workers. The actual elasticity values used range from 0 to 1 (see Appendix B).

In each closure we assume that half of the capital stock used in each industry is fixed (immobile), while the other half is mobile (it can be reallocated across industries).[7] We also assume that trade plus international capital flows add to zero (balance of payments equilibrium). Finally, we assume that net additions to the government's budget position are reflected in savings–that is, we do not enforce revenue neutrality. This assumption has implications for our results. Since the effect of a shock is to reduce the budget deficit (i.e. to increase net government savings), then our measures of welfare, which are based on household real expenditures, will understate the true welfare change associated with that shock. An alternative closure assumption would be to require that the government maintain a fixed budget deficit or surplus by imposing a lump-sum tax or transfer on households. However, this assumption is inconsistent with Vietnamese reality. In our presentation of simulation results later in this paper, we note that the predicted changes in government savings are a tiny fraction of total government expenditure, which in turn is less than one-fifth of GDP, so the cost (in terms of potential bias in our welfare measure) of a more realistic assumption about the government budget is very small indeed.

The model's numéraire price is the nominal exchange rate of domestic currency for US dollars, assumed fixed. World prices of imports are exogenous; those of exports are not, but the values of export demand elasticities are large enough that these prices are fairly unresponsive to changes in export quantities.

The model contains data on 16 household types, distinguished by location (urban/rural), sex of household head, and primary income source (farm, self-employment, wage work, not in labor force). These types are as defined in the SAM. Households earn income from ownership of primary factors and transfers, and spend it on a range of goods, whether produced domestically or imported from abroad.

For purposes of welfare analysis, we augment the household data by linking our model to the corresponding data from VHLSS 2004, which contains information on incomes and expenditures by a representative sample of 9,175 households nationwide. This mapping makes it possible to draw conclusions about the effects of the shock on income distribution and poverty, both nationally and for subsets of the population, such as urban and rural households and geographic regions. Each

household in the VHLSS dataset is identified by the characteristics listed in the previous paragraph as belonging to one of the 16 household groups in the SAM. However, each VHLSS household has its own unique data identifying shares of income (from land, labor by skill and sex of worker, capital, and transfers), and its own unique share of expenditures devoted to food and non-food items. From the AGE experiments we obtain values of changes in wages and other factor returns, transfers, and consumer prices. We then use these to compute changes in income and living costs for each household. By this means we can map the economy-wide results onto real income changes and poverty changes by household. Thus, the model is fully simultaneous at the level of the 16-household aggregates, with a recursive microsimulation from these to the full VHLSS household dataset.

4.3 Experiments: rice price shock

Our policy experiment replicates the effects of a step increase in world rice prices. The Vietnamese economy experiences a terms of trade gain when the export price rises, and net rice producers within the domestic economy are expected also to benefit. However, to the extent that the price rise is passed on from traders and producers to domestic consumers, it also has negative impacts. Moreover, as the *ex ante* model in section 2 made clear, there may also be substantive indirect effects from adjustment in markets other than that for rice. We explore these by repeating the experiment under alternative assumptions about labor mobility and labor supply, as already described.

Before turning to the AGE results, it is illuminating to compare the approximate partial equilibrium impacts of the rice price increase. We do this by applying the food price increase to a variant of the model in which we assume the labor market to be slack (so there are no endogenous wage effects) and calculating the effects on household income of changes in the price of food and the returns to land used for food (specifically, rice) production. With no changes in wages or transfers, equation (8) shows that the household-level impact of the price increase will depend only on the expenditure share of food and the share of rice-producing land in total income. Table 5 shows the calculations and results for the 16 basic household types. In our data, unlike the heuristic model in equation (8), non-labor farm income is derived from two distinct sources, land and fixed capital. Columns 1 and 2 show shares of income from farmland (in all uses) and from farm-specific capital. Based on these, columns 3 and 4 show growth of gross income, computed first for all farmland, and second for rice land only. Column 5 shows growth in the cost of living due to the food price rise. Deducting this from income growth gives the final two columns, which show equivalent variation based on income from all farmland and from rice land only. The “all agriculture” column shows that the mean household in every category suffers a real loss from the food price rise. The “rice only” column confirms that the only household groups to gain from the price shock are those whose main income is from rice farming; their gains (relative to business as usual) range from 2.6% up to 3.7%. The losses

experienced by all other household groups are in proportion to the values of their food budget shares, and range from –0.75% down to –2.66%.

These welfare change results reproduce, for rather broad household groups, those reported in the partial equilibrium studies discussed in section 1. Since rice farm households account for a large share of the poor population, aggregate poverty may diminish even as all other groups experience declining real income and rising poverty. These results, however, take no account of endogenous changes in non-food prices or in non-farm factor rewards—including wages, which account for a large share of household income (Table 2). Accordingly, we now turn to the AGE experiments using the three closures previously described. The results, for a 35% rice export price increase, show changes predicted to take place over and above the effects of 'business as usual' growth. Table 6 summarizes the main macroeconomic results; Table 7 summarizes the main effects on wages and employment by labor type, and Table 8 shows effects on poverty and income distribution by household type.[8]

The first rows of Table 6 show percentage changes in rice prices at key points in the value chain. Consistent with the empirical estimates in section 3, the predicted rise in domestic rice prices is about 80% that of the border price rise. Paddy prices, however, rise by much less, only about 1/3 of the border price. This large difference between changes in producer and consumer prices is consistent with the margin shown in Figure 3, though it is notably at odds with the simplified unitary price model used in section 2. We explore the welfare implications of this difference below.

As expected, in the short run (with labor fixed by location, and no change in labor supply) the shock has very little effect on GDP. GDP growth is faster (0.02%) when migration is possible, and faster still (0.34%) when some types of labor are elastically supplied (third column). The relaxation of supply constraints also reduces somewhat the rate of CPI increase: inflation accelerates by 0.84% as opposed to about 0.95% when aggregate resources are fixed. Paddy output expands sharply, by 11.5% to 12.4% depending on the closure. Overall agricultural output increases slightly (0.37%) when labor is immobile, but by more (0.73%) when migration occurs, and even more (1.15%) when labor is elastically supplied. Manufacturing output (which includes processed food products using paddy as an input) increases slightly in the first two closures, and by more when labor becomes more abundant overall. Services output is crowded out by wage increases in the first two closures, but this effect becomes negligible with more elastic labor supply. The pattern of employment changes reflect that of output changes except in paddy production, where labor use rises by as much as 1.4 times faster than output. Taken together, these GDP and sectoral results underscore the complementarity of labor mobility and economic growth.

How much difference do indirect effects through factor markets make? Not surprisingly, given the labor income shares in Table 2, the answer is "a lot". Table 7 shows nominal changes in factor

returns and employment. When labor is immobile across locations, all gains from higher rice prices accrue to rural workers, while urban workers experience a slight nominal loss—to which must be added an additional loss due to higher living costs (Table 6). Labor immobility excludes urban workers from the direct gains of growth and so contributes to a substantial narrowing of the urban-rural wage gap. This changes, however, when migration is possible. In closure 2, agriculture can hire new workers from either urban or rural areas.[9] Now, wage growth occurs at identical rates for rural and urban workers of each type, and so the gains from agricultural growth are spread more evenly across regions. Because agriculture is intensive in unskilled labor inputs, however, the gains of medium-skill workers are less than half those of their unskilled counterparts, and high-skill workers still experience both nominal and real wage declines.

In the third closure, the supply of (mainly) low-skill labor is more elastic. The increase in its supply (at 0.73%, a small percentage change but in a very large fraction of the total labor force) raises the productivity of workers of all other skill types—and of non-labor factors. Nominal wages of medium and high-skill workers now rise more substantially, while the increase in low skill wages dips sharply, from around 2.9% with fixed labor supply to around 1.7% with more elastic supply. Owners of land and capital also benefit from the increase in those factors' relative scarcity.

Table 7 conveys several key insights concerning the distribution among factor owners of gains from the rise in world rice prices. First, the importance of rice in total employment means that wage effects are substantial, suggesting that to measure the impacts of food price shocks in partial equilibrium is to miss a large part of the welfare change story. Second, labor market adjustment has a powerful conditioning effect on the distribution of gains and losses. Spatial labor immobility causes income gains and losses to be "trapped" by location, whereas migration spreads them relatively evenly throughout the economy. Migration also permits a greater degree of sectoral adjustment to new prices; this is reflected in skill-specific wage changes. Finally, when some factors (in this case, low-skill labor) are elastically supplied, total income can grow faster, but changes in relative factor scarcity award a larger share of the gains from growth to factors *other than* those whose supply increases. It follows that the full answer to any question concerning the distribution of gains and losses from a food price shock depends on much more than the net consumer-net producer dichotomy, and indeed is highly sensitive to the form and degree of labor market response.

Indirect effects of the rice price shock contribute to the range of predicted poverty consequences (Table 8). Aggregate and average household income changes are modest, in line with the small change in overall GDP. In the no-migration case, higher prices reduce the rural poverty headcount by 1.8% but raise urban poverty by 2.2%; as a result, the national poverty rate declines by 1.19%, or from 19.1% to 18.9%.[10] Proportionally, changes in the poverty gap are similar. When migration occurs, both the overall poverty reduction and its distribution between urban and rural regions

diminish, because then the gains from agricultural growth are shared via interregional labor market adjustment. This effect is even more pronounced when the supply of (mainly) low-skill labor is elastic. In fact, since the net effect is to raise returns to inelastically supplied factors, our results indicate that the distribution of gains between rural and urban regions is reversed, with larger poverty declines observed in the latter than in the former.

Finally in this discussion of welfare, we return to the question of gains by net rice producers. As Table 6 showed, the producer rice price rises by just 1/3 of the consumer price. For a household to gain from these changes alone—independently of other price and income changes arising in general equilibrium—rice production as a share of its income must be roughly three times greater than the share of rice in its consumption expenditures. Nationally, and by administrative region, only slightly more than half the households that are net rice sellers meet this criterion, or about 11.5% of the total household population (Table 9). In other words, even among net rice producers, only the largest commercial farmers can be sure that the direct impact of a rice price rise will actually increase their welfare. As the table shows, these farmers are highly concentrated by region, primarily in the Mekong Delta.[11]

There is, of course, a limit to what can be learned from comparisons of aggregates, since these ignore within-group variation. To obtain a more complete view we plot the distribution of welfare changes, ordered from lowest to highest, across centiles of the urban and rural subpopulations. Figures 4 and 5 show this for all rural and all urban households. In Figure 4, without migration (closure 1) only 17% of rural households experience any income decline. When labor is more mobile (closure 2) and more elastically supplied (closure 3), labor market gains are more broadly shared and as a result, larger proportions (46% and 49% respectively) of rural households experience real income declines; moreover, the welfare gains are now lower over almost the entire distribution. For urban households (Figure 5), almost the opposite story applies. In the no-migration case nearly all (96%) experience an income decline, but as the labor market becomes integrated across regions, this figure drops sharply to 69% (closure 2) and 23% (closure 3). Almost exactly the same pattern can be seen among initially poor households (Figures 6 and 7). 88% of poor rural households experience rising real income when labor mobility is limited, but fewer than half do so when labor is more mobile (Figure 6), and their gains are lower across the whole distribution. Meanwhile the urban poor are big winners from labor mobility (Figure 7).

By contrast with the partial equilibrium results reported in section 2, this experiment clarifies the role of general equilibrium linkages in a largely agrarian, low skill-labor intensive economy. The AGE model allows for labor market responses, whereas partial equilibrium approaches count only those effects emanating from the rice market itself. When other markets—and in particular, that for labor—adjust, higher rice prices translate into a higher marginal value product of low-skill labor. Since this

is the primary income source of the poor, it alters the incidence of the price shock, spreading the gains more evenly between net rice producers and net consumers. When we apply predicted factor and product price changes from the AGE model to the VHLSS data, changes in returns to labor account for almost 300% of the average real income change—about the same magnitude, though of opposite sign, as the effect of higher consumer prices (340%), and an order of magnitude greater than the contribution from higher land returns (38%). Finally, contrasting results across the three closures confirm that in Vietnam, the intersectoral labor market is one of the most important conduits for distributing the gains from growth, even when the growth itself takes place in specific locations and industries.

6. Conclusions

Rising global food prices have sparked serious concerns about impacts on purchasing power and welfare in low-income economies, even in net exporters like Vietnam. We find first that due to low price transmission, the extent of the global price shock of 2007-08 was much smaller in Vietnamese domestic markets than might have been expected, especially when compared with the underlying, longer term rising food price trend. AGE simulation experiments replicate the rice price data, predicting that producer prices rise about one-third as fast as consumer prices. Recursive extrapolation to a 9,175-household income and expenditure database reveals the extent to which the direct effect of the rice price increase reduces household welfare, especially among the poor. Even among the 21% of households nationally that are net sellers of rice, only half (or 11.5% of all households) sell a fraction of their output large enough to ensure that their income gains outweigh their losses as consumers.

However, the general equilibrium results also show clearly the importance of the labor market as moderating influence. In the short run (when labor markets do not clear across regions), rural workers and small farmers, who make up the largest poor subpopulation, capture large indirect gains through the employment and labor productivity effects of higher rice prices. Longer-run, these gains are dissipated somewhat through interregional migration; nevertheless, wage and employment effects persist as important determinants of changes in household welfare and poverty. These phenomena are missing from partial equilibrium analyses.

As we see it, there are several types of longer-run issue that merit further research. The first is empirical. Was any of the new income associated with the shock spent in ways that enhance the productivity of the poor, or increase their capacity to withstand future shocks? What part, if any, of the windfall to rice millers and exporters has been plowed back into agricultural investments, or will be available for stabilization purposes in the event of a future price decline? The state trading firms that dominate Vietnamese rice exports are required by their charters to apply part of their profits to

the promotion of agricultural development. If this mandate were to be observed in practice, one might expect to see increased investments in infrastructure such as farm-to-market roads and storage facilities, better provision of intermediates such as fertilizer and seeds, and perhaps higher agricultural R&D spending. The long-run payoff to such investments would be higher farm profits, and potentially more fiscal resources available to stabilize consumer prices.

Our results also draw attention to policy responses. There is widespread concern that windfall gains by state-owned rice traders in 2007-08 were used neither in defense of short-term stabilization nor to promote longer run productivity growth. Since the state traders are nominally charged with fulfilling government-mandated goals, this leaves a question mark over the efficacy of policy responses to the rice crisis—including the brief export ban. Further research is needed to ascertain how much of the difference between global and domestic price trends is due to genuine stabilization, and how much to rent capture by the two dominant exporters.

Finally, many methodological issues remain. The general equilibrium approach accounts for effects of the food price shock on markets not frequently considered by "impact" analyses. But in the longer run there is of course scope for even more flexibility as factors (including land and capital) are reallocated among activities, production technologies respond to new factor scarcities, and consumers make longer-term adjustments to spending and savings plans. Moreover, as noted at several points above, both impact and response have potentially important regional dimensions; ideally these too should be incorporated in an improved and expanded model. Capturing market responses and regional disaggregation requires a model of considerably greater sophistication than that used here, backed by new data on intertemporal responses by households, firms and government. As the global food price rise of the mid-2000s increasingly seems more like a permanent shift than a temporary shock, these reactions will need to be incorporated into future analyses.

Appendix A: Calculating counterfactuals

In this appendix we calculate the extent of the 2007-09 rice price rise, taking account of the underlying long-term price trend and other factors. The domestic rice price is related to the f.o.b. world price p_f^W through the nominal exchange rate E, the export tax equivalent t_f, and relevant export margins, m_f. In growth rate form, the domestic rice price grows as follows:

$$\hat{p}_f = \hat{p}_f^W + \hat{E} - \hat{m}_f - \frac{t_f}{1-t_f}\hat{t}_f$$

In the long run, a shock to global rice prices may be large enough to affect the nominal exchange rate. But more immediate concerns exist about the value of the margin from the f.o.b. price to domestic producers or consumers, and that of the export tax rate equivalent, t_f. Our analysis in the text shows the pass-though margin to have changed significantly during the rice price boom. Moreover the Vietnamese government, in applying a short-lived ban on the signing of new export contracts in mid-2008, exogenously altered the value of t_f. So computation of the counterfactual domestic price trend must be based on pre-crisis values of these terms. From the data, the average annual rise in f.o.b. prices in the pre-crisis years, 2001-2006, was 7.81% (North) and 7.59% (South). Using these rates, the counterfactual price rise can be computed for 2007-09. The actual price and predicted domestic price increases are shown in Table A-1.

Table A-1: Actual and predicted rice price increases, 2001-09 (percent)

	North	South
Actual price increase 2001-06 (annual %)	7.81	7.58
Actual price increase 2007-09 (annual %)	15.05	17.16
Total price increase 2006-09	65.85	71.67
Counterfactual price increase 2006-09	35.09	33.97

In closing, it is important to note that these computations are specific to the historical period from which the data are drawn. There is no implication that a similar world price shock in the future would elicit a similar domestic price response, whether in terms of margins or rice export policies.

Appendix B: Assumed values for labor supply elasticities

In Vietnam, official sources report urban unemployment rates to be roughly steady at around 5-6%, and the ratio of rural hours worked to hours available at about 75% (reported in Brassard 2004). About 13% of rural workers are reported in official statistics as working less than full-time and seeking more hours of work in a week (Coxhead et al. 2009, Table 6). Based on our evaluation of such admittedly fragmentary data, we surmise that the supply of labor by rural workers is in general more elastic than that for urban workers; that by rural females is especially more elastic than for their urban counterparts, and the supply is more elastic for low skill labor than for medium or high-skill labor. We build a vector of labor supply elasticity values from these conjectures. The assumed values (see table A-2) range from 1 for the most elastic supplies, to 0.1 for the least. The estimation of labor supply parameters directly from household and individual data is the subject of our ongoing empirical research.

Table A-2. Assumed values of labor supply elasticities

Labor type	Rural	Urban
Male low skill	1.0	0.5
Male medium-skill	0.1	0.1
Male high-skill	0.1	0.1
Female low skill	1.0	0.5
Female medium-skill	1.0	0.1
Female high-skill	0.1	0.1

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Tables and figures

Table 1: Household poverty in Vietnam, 2004

	Number of people (000)	Population share (%)	Headcount poverty rate (%)	Share in poor pop'n (%)
Rural	60,017	74.2	21.78	84.77
Urban	20,849	25.8	11.26	15.23
Total	80,866	100.0	19.07	100.00

Source: Computed from VHLSS 2004.

Table 2. Shares in household income and expenditure (per cent) by household group

	Income					Expenditure		
Household group	Labor	Land	Capital	Transfers	Total	Food	Other	Total
Rural								
MH self-emp farm	64.88	11.81	7.35	15.96	100	55.4	44.6	100
MH self-emp nonfarm	58.68	2.19	33.96	5.17	100	50.6	49.4	100
MH wage earner	81.20	5.43	4.19	9.18	100	51.7	48.3	100
MH not in labor force	0.00	0.00	0.00	100.00	100	50.7	49.3	100
FH self-emp farm	60.26	10.13	8.48	21.13	100	53.3	46.7	100
FH self-emp nonfarm	62.31	1.57	18.80	17.32	100	49.8	50.2	100
FH wage earner	75.82	2.90	5.23	16.05	100	53.7	46.3	100
FH not in labor force	0.00	0.00	0.00	100.00	100	51.0	49.0	100
Urban								
MH self-emp farm	68.75	2.14	9.49	19.62	100	47.2	52.8	100
MH self-emp nonfarm	37.52	0.06	50.67	11.75	100	43.5	56.5	100
MH wage earner	71.73	0.22	12.48	15.57	100	40.3	59.7	100
MH not in labor force	0.00	0.00	0.00	100.00	100	44.1	55.9	100
FH self-emp farm	44.81	3.12	12.39	39.68	100	47.2	52.8	100
FH self-emp nonfarm	48.13	0.02	30.29	21.56	100	42.0	58.0	100
FH wage earner	67.11	0.03	13.04	19.83	100	40.2	59.8	100
FH not in labor force	0.00	0.00	0.00	100.00	100	42.5	57.5	100

Notes: MH: male-headed; FH: female-headed

Source of basic data: Vietnam Social Accounting Matrix, 2004.

Table 3: Long-run pass-through elasticity (static model)

	North		South	
Whole period (Jan, 2001-Dec, 2009)	Coef.	t-stat	Coef.	t-stat
Log of export prices	0.857	34.81**	0.870	32.89**
Constant	1.260	6.10**	1.048	4.71**
ADF Test for residuals	-3.25		-3.24	
5% critical values	-2.89		-2.89	
Pre-crisis period (Jan, 2001-Feb, 2007)				
Log of export prices	0.732	18.92**	0.724	23.07**
Constant	2.249	7.16**	2.212	8.68**
ADF Test for residuals	-3.27		-3.10	
5% critical values	-2.92		-2.92	
Crisis period (March, 2007- Dec, 2009)				
Log of export prices	0.608	8.35**	0.603	6.99**
Constant	3.522	5.41**	3.486	4.53**
ADF Test for residuals	-1.59		-1.78	
5% critical values	-2.98		-2.98	

Table 4: Pass-through elasticity: error correction model

Dependent variable: Δ(domestic prices)	North		South	
	Coef.	t-stat	Coef.	t-stat
Whole period				
Δ(export prices)	0.153	2.80**	0.105	1.83*
Lagged domestic prices	-0.226	-6.29**	-0.207	-5.88**
Lagged export prices	0.210	6.54**	0.200	6.28**
Constant	0.162	1.84*	0.054	0.62
R-square	0.356		0.311	
Number of observations	100		100	
Short-run pass-through elasticity	0.153		0.105	
Long-run pass-through elasticity	0.927		0.970	
Error-correction coefficient	0.210		0.200	
Pre-crisis period				
Δ (export prices)	-0.208	-1.65*	0.000	0.00
Lagged domestic prices	-0.313	-4.79**	-0.306	-5.03**
Lagged export prices	0.253	4.91**	0.245	5.25**
Constant	0.520	2.28**	0.497	2.67**
R-square	0.303		0.310	
Number of observations	66		66	
Short-run pass-through elasticity	-0.208		0.000	
Long-run pass-through elasticity	0.809		0.799	
Error-correction coefficient	0.253		0.245	
Crisis period				
Δ (export prices)	0.185	2.81**	0.076	0.82
Lagged domestic prices	-0.257	-4.57**	-0.263	-3.95**
Lagged export prices	0.199	4.88**	0.196	3.76**
Constant	0.537	1.87*	0.599	1.6
R-square	0.570		0.382	
Number of observations	34		34	
Short-run pass-through elasticity	0.185		0.076	
Long-run pass-through elasticity	0.774		0.745	
Error-correction coefficient	0.199		0.196	

** significant at 5%; * significant at 10%.

Table 5. Direct (partial equilibrium) impacts of a rice price shock on real household income

	Income shares[a]	Gross income	Cost of	Equivalent

Household group	Land	Ag. Capital	change (%) All agric.[b]	change (%) Rice only[c]	living change (Food)[d]	variation (%) All agric.[b]	variation (%) Rice only[c]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rural							
MH self-emp farm	11.81	7.35	1.36	5.69	2.82	-1.47	2.86
MH self-emp nonfarm	2.19	0	0.16	0.50	2.28	-2.11	-1.78
MH wage earner	5.43	0	0.41	1.24	2.40	-1.99	-1.15
MH not in labor force	0	0	0.00	0.00	2.25	-2.25	-2.25
FH self-emp farm	10.13	8.48	1.30	5.76	2.70	-1.40	3.06
FH self-emp nonfarm	1.57	0	0.12	0.36	2.07	-1.95	-1.71
FH wage earner	2.9	0	0.22	0.66	2.06	-1.85	-1.40
FH not in labor force	0	0	0.00	0.00	2.66	-2.66	-2.66
Urban							
MH self-emp farm	2.14	9.49	0.77	4.34	1.70	-0.93	2.64
MH self-emp nonfarm	0.06	0	0.00	0.01	1.28	-1.27	-1.26
MH wage earner	0.22	0	0.02	0.05	1.11	-1.09	-1.05
MH not in labor force	0	0	0.00	0.00	1.22	-1.22	-1.22
FH self-emp farm	3.12	12.39	1.03	5.74	2.00	-0.98	3.74
FH self-emp nonfarm	0.02	0	0.00	0.00	0.92	-0.92	-0.92
FH wage earner	0.03	0	0.00	0.01	0.76	-0.76	-0.75
FH not in labor force	0	0	0.00	0.00	0.83	-0.83	-0.83

Notes: a. From Table 2, assuming only farm households earn from farm capital. b. Average for all agricultural sectors. Change in land price = 7.5%, change in fixed capital return = 6.4%. c. Average for rice farming only. Change in land price = 22.9%, change in fixed capital return = 40.6%. d. Cost of living change: food expenditure share X change in food price index.

Table 6: Effects of global price shock on rice market and the macroeconomy (percent change)

	Labor market assumptions		
	No migration, fixed labor supply	Migration, fixed labor supply	Migration, flexible labor supply
Rice prices			
Margin-inclusive export price	28.72	28.62	28.52
Net domestic consumer price	23.79	23.58	23.44
Farm-gate (paddy)	8.80	8.35	8.16
Change in real GDP	0.014	0.020	0.342
Change in CPI	0.954	0.955	0.842
Change in G savings (% initial G. exp)	0.489	0.402	0.607
Output change: paddy & agg. sectors			
Paddy	11.465	11.952	12.420
Agriculture	0.375	0.732	1.147
Manufacturing	0.329	0.305	0.562
Services	-0.046	-0.394	-0.060
Employment change: paddy & agg. sectors			
Paddy	15.100	16.500	17.100
Agriculture	0.656	1.198	1.924
Manufacturing	0.062	-0.036	0.466
Services	-0.155	-0.714	-0.198

Table 7: Wage and employment effects of rice export price increase (Percent change)

	Labor market assumptions		
	No migration, fixed labor supply	Migration, fixed labor supply	Migration, flexible labor supply
Change in wage (%)			
Male rural low skill	4.14	2.92	1.71
Male rural medium-skill	4.13	1.25	1.84
Male rural high-skill	4.19	-0.71	0.83
Female rural low skill	4.13	2.90	1.71
Female rural medium-skill	4.13	0.87	1.46
Female rural high-skill	4.19	-0.50	0.98
Male urban low skill	-0.35	2.92	1.71
Male urban medium-skill	-0.35	1.25	1.84
Male urban high-skill	-0.35	-0.71	0.83
Female urban low skill	-0.35	2.90	1.71
Female urban medium-skill	-0.35	0.87	1.46
Female urban high-skill	-0.35	-0.50	0.98
Change in non-labor factor returns (%)			
Rice/annual crop land only	20.41	21.01	21.81
All land (average)	5.82	6.07	6.72
Mobile capital	0.04	-0.07	0.39
Fixed capital (average)			
Agriculture	4.73	4.99	5.63
Manufacturing	2.11	2.22	2.99
Services	1.04	0.73	1.23
Employment change: Low skill	0*	0*	0.73
Medium skill	0*	0*	0.26
High skill	0*	0*	0.01

* Fixed at zero by assumption.

Table 8: Poverty and income distribution effects of rice export price increase

		Labor market assumption		
		No migration, fixed labor supply	Migration, fixed labor supply	Migration, flexible labor supply
	Baseline	Percentage change from baseline		
Real per capita income (VND*10^6)				
Whole country	499	0.132	0.235	0.281
Urban	809	-1.004	-0.894	0.419
Rural	395	0.942	0.236	0.183
Poverty headcount, %				
Whole country	19.1	-1.193	-0.801	-0.376
Urban	11.3	2.200	0.407	-1.695
Rural	21.8	-1.806	-1.019	-0.138
Poverty gap, %				
Whole country	4.84	-1.284	-0.614	-0.433
Urban	2.43	4.112	0.304	-2.452
Rural	5.69	-2.088	-0.750	-0.132

Source: Calculated from AGE results using VHLSS data.

Note: Poverty lines are from the General Statistics Office, and are set (in 2004 prices) at VND 200,000/month (about $US0.42/day) for rural, and VND 260,000/month ($US0.55/day) for urban areas. Source: http://www.gso.gov.vn/default.aspx?tabid=503&ItemID=2948, accessed 12/4/2011.

Table 9: Net producers and net winners from *ceteris paribus* rice price rise[a]

	Net producers (%)	Net winners (%)
Whole country	20.86%	11.56%
By region:		
Red River Delta	24.24%	9.43%
North East	5.00%	2.19%
North West	3.85%	1.83%
North Central Coast	23.49%	10.75%
South Central Coast	19.65%	10.19%
Central Highlands	7.45%	5.38%
North East South	6.48%	5.74%
Mekong River Delta	45.18%	27.39%

Source: Calculated from region-weighted 2004 VHLSS data and price changes in Table 6.

a. Net producers: households for which rice production exceeds consumption. Net winners: for farm-gate and consumer price changes shown in Table 6, income and expenditure shares are such that household real income rises, holding constant other prices, factor incomes and transfers.

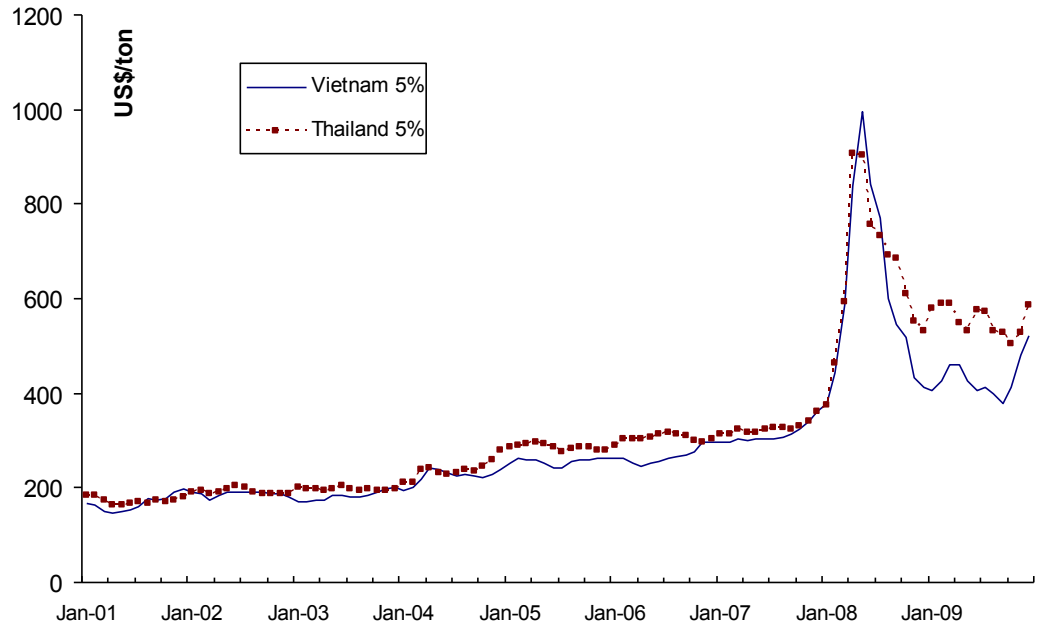

Figure 1: Prices of rice exported from Thailand rice and Vietnam (5% broken)

Source: Vietnam rice 5%: FAO Rice Market Outlook and Rice Price Update, various issues; Thailand rice 5%: World Rice Statistics, IRRI.

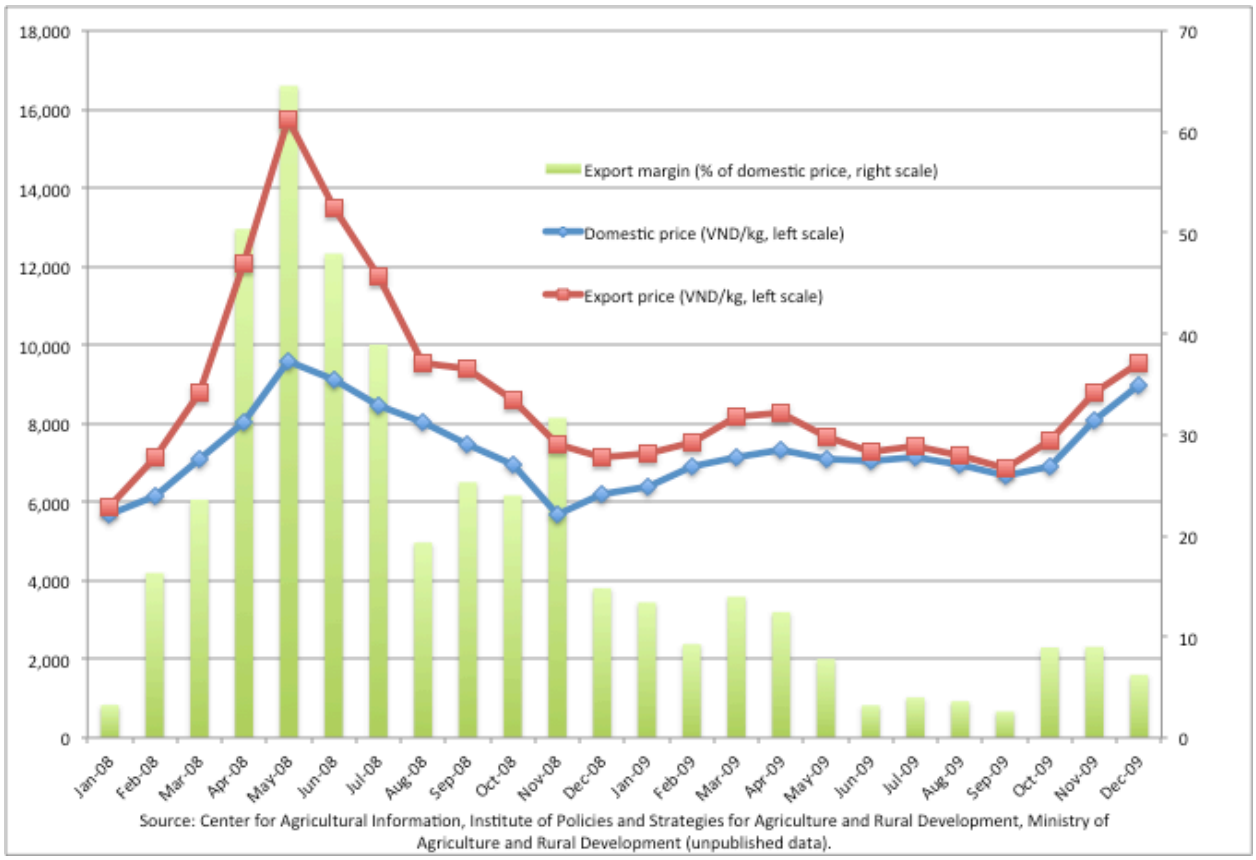

Figure 2: Domestic and export rice prices, and export margins, 2008-09

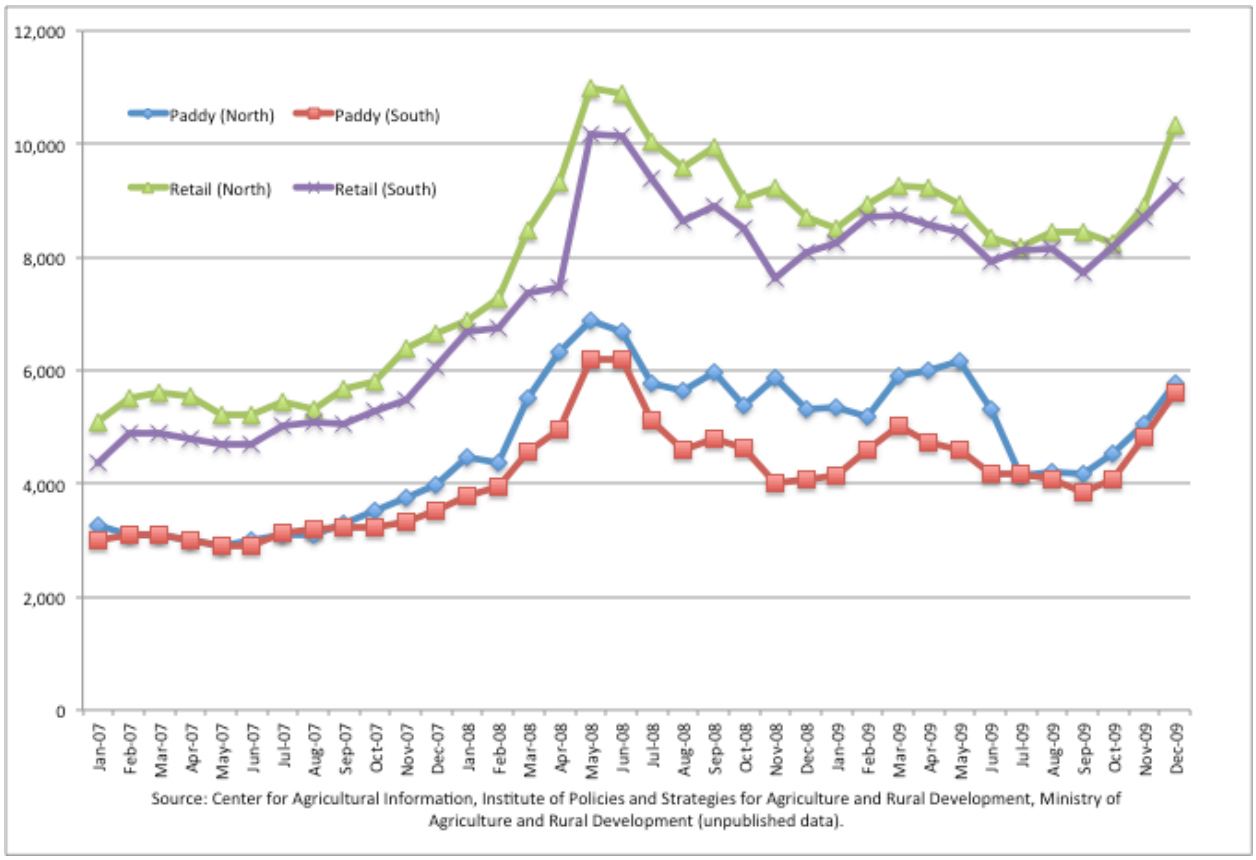

Figure 3: Producer and consumer rice prices, 2007-09 (VND/kg)

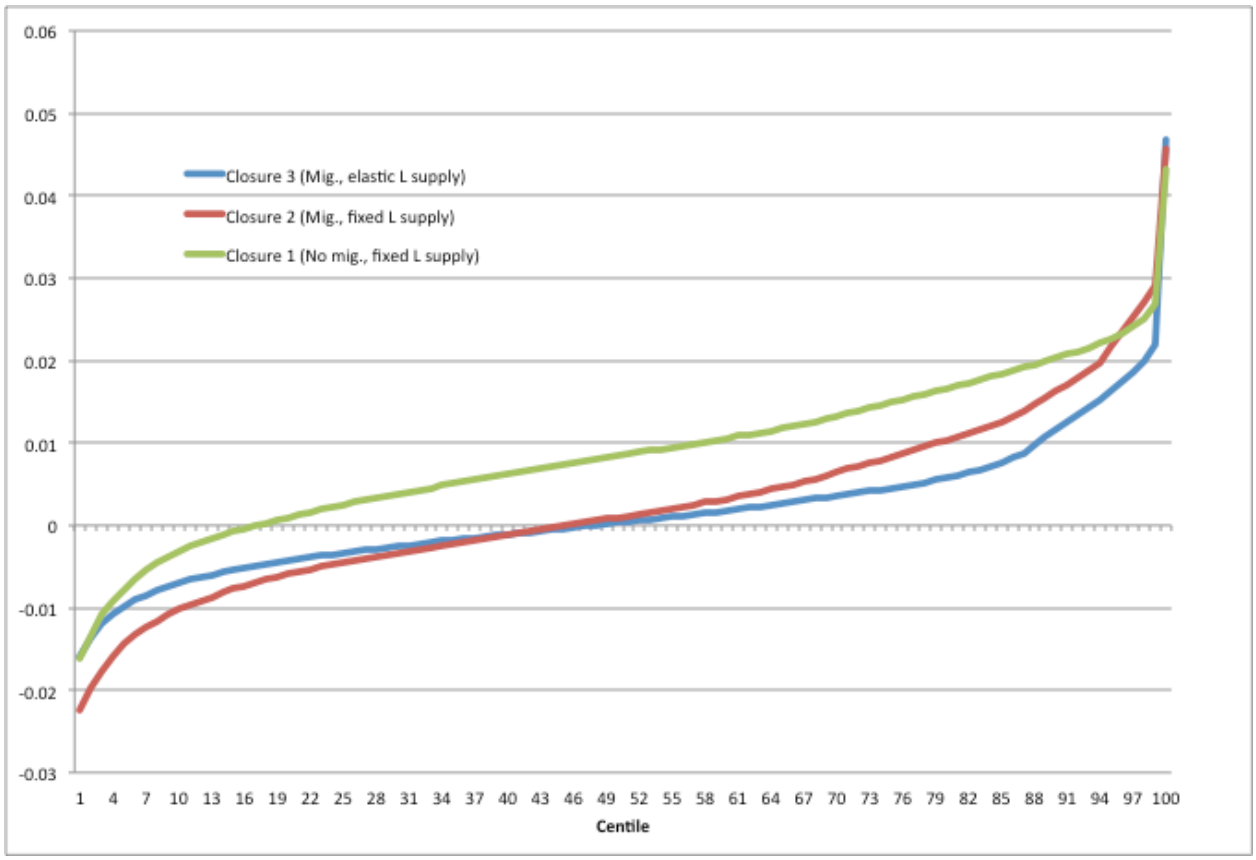

Figure 4: Distribution of income changes (%), all rural households (n=6898)

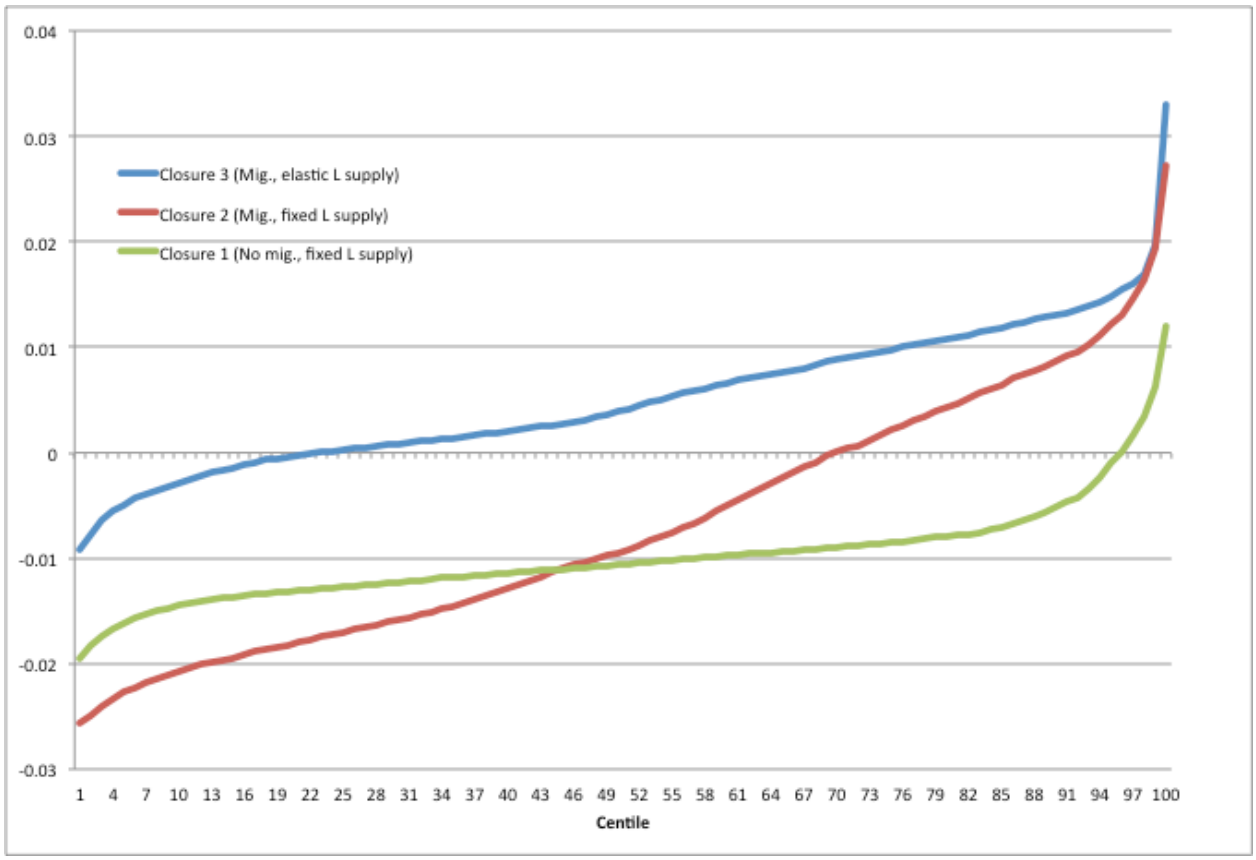

Figure 5: Distribution of income changes (%), all urban households (n=2241)

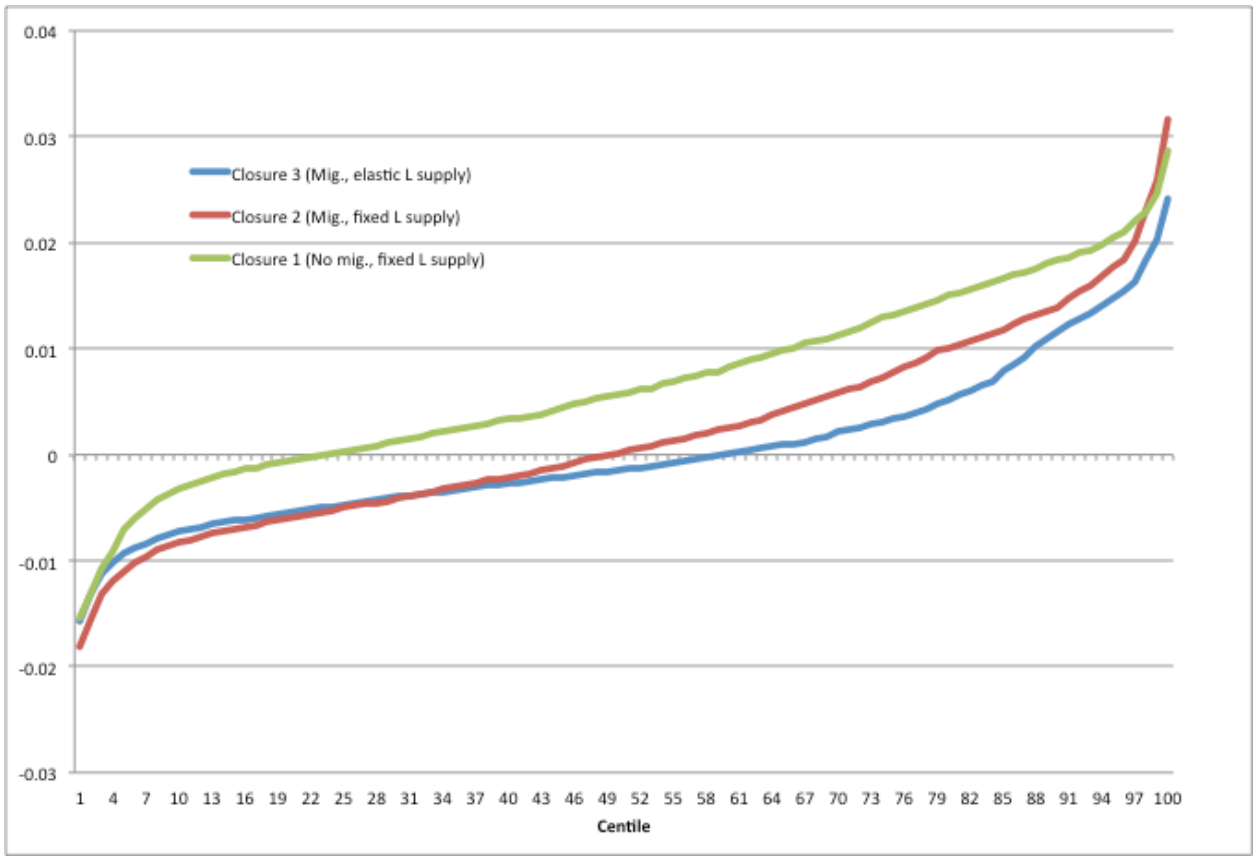

Figure 6: Distribution of income changes (%), poor rural households (n=1468)

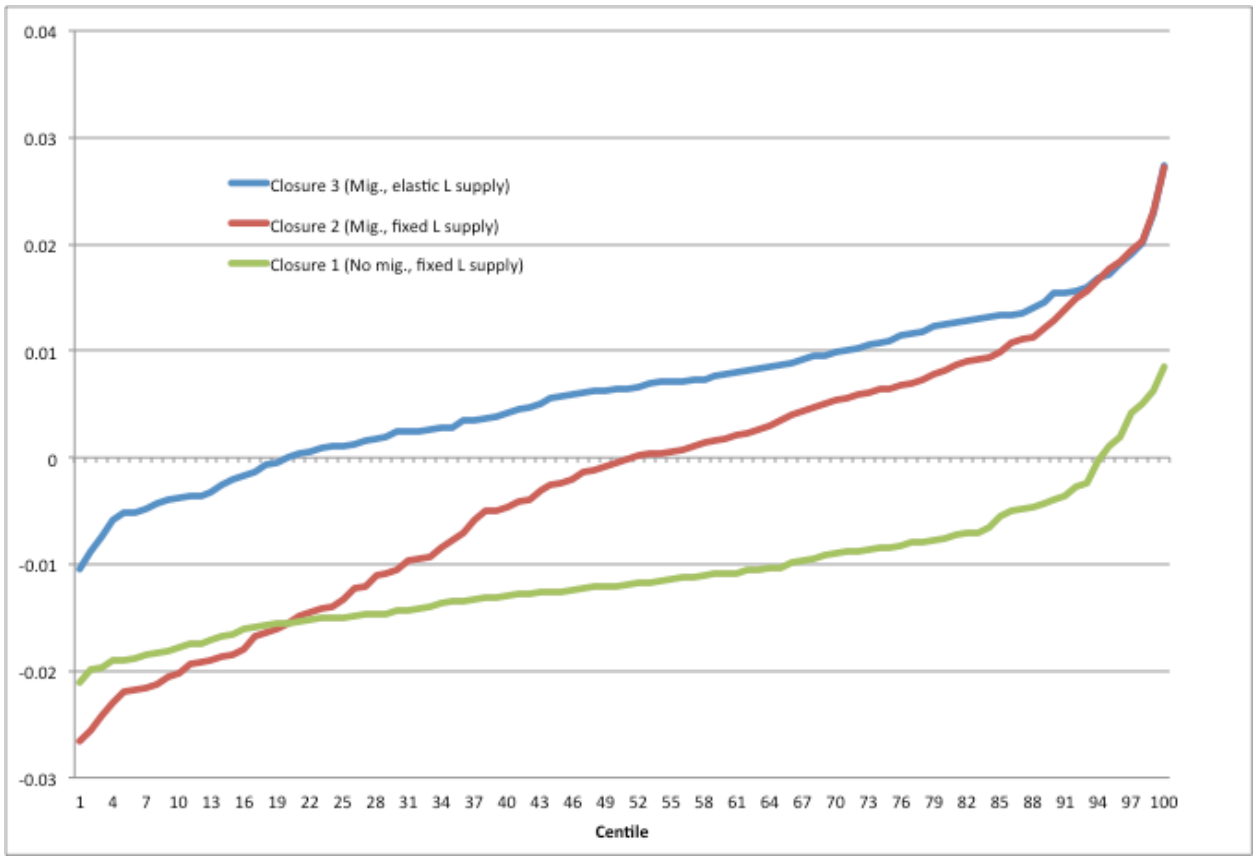

Figure 7: Distribution of income changes (%), poor urban households (n=279)

Endnotes

[1] Including, notably, a 2008 special issue of *Agricultural Economics,* several papers from which are useful reference points for our study.

[2] The expression relies on the envelope theorem. The optimized functions $c_i(p,w,u)$ and $-L_i^S(p,w,u;T)$ are homogeneous of degree zero in (p,w). Young's theorem (symmetry of second-order derivatives) allows us to rearrange terms so as to use Euler's theorem to eliminate second-order terms from the solution.

[3] The optimized farm profit function is $\pi(p_f, w_f, T) = Tr_f(p_f, w_f, T) \equiv p_f q_f(p_f, w_f, T) - w_f L_f(p_f, w_f, T)$. So the total differential is $Tdr_f = p_f q_f - L_f dw_f$.

[4] Minot and Goletti (2000) found evidence of significant north-south barriers to internal rice market integration for earlier years, 1985-95. A study with more recent data, however, finds that regional markets are integrated in the long run (Baulch et al. 2008).

[5] Exports as a fraction of domestic production did decline slightly from 2007 to 2008 (production and trade data from www.gso.gov.vn, accessed 4 December 2011).

[6] Vietnam's land-labor ratio, at 0.114 ha/resident in 2007, is among the lowest in the developing world. Compare China (0.168), Indonesia (0.249) and Thailand (0.522). Source: FAOSTAT, www.fao.org.

[7] The Vietnam SAM does not distinguish between fixed and mobile capital inputs. In the absence of more information we have assumed a 50-50 division of the capital use values. We also check the robustness of simulation result with respect to this division. The main results exhibit minimal sensitivity to large changes in the fixed-mobile capital split (details and data available on request).

[8] More detailed results are available on request.

[9] Our model assumes zero migration costs.

[10] Poverty lines are defined in a footnote to Table 8.

[11] As expected, the regional distribution of gains and losses is heavily influenced by the extent to which each region is a net "exporter" of rice. Kompas et al. (2010) explore the regional distributions of gains and losses with an 8-region CGE model; however their paper does not specify whether labor and other markets clear across regions or between them, so comparisons with our findings are difficult.