ABSTRACT

Title of dissertation: ESSAYS ON COMMODITY MARKET LIBERALIZATION, SPATIAL COMPETITION AND FARMER'S PRICE.

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This dissertation examines the effects of commodity market liberalization on the farmer's price. Chapter two of this dissertation presents a theoretical model of commodity market liberalization which aims to analyze the impact of market liberalization on the farmer's price. This monopsony-type model includes three main features often studied separately in the literature: spatial competition among buyers, transaction costs, and the international environment. The model replicates the mixed results observed following commodity market liberalization. It also stresses the fact that the outcome of commodity market liberalization is ambiguous, unless the three features listed above can be controlled.

The empirical model developed in chapter three is one of the few models that take advantage of the recent developments in the field of spatial econometrics, the availability of household survey data, and geographical information data in order to analyze the market reforms in developing countries. The empirical model tests for price competition and transaction costs using the Generalized Spatial Two-Stage Least Squares (GS2SLS) procedure, developed by Kelejian and Prucha (1998). The data is a two-period panel household survey data of rice farmer in Vietnam. The results show the presence of price competition among buyers during the two markets regimes. In addition, the level of competition decreases after the market liberalization. Regarding

transaction costs, proportional transaction costs decrease after the market liberalization while fixed transaction costs do not affect farmer's price during both market regimes.

ESSAYS ON COMMODITY MARKET LIBERALIZATION, SPATIAL COMPETITION AND FARMER'S PRICE.

By

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DEDICATION

To my mother, KOUDOU, Anne Marie Clementine:

For carrying the *burden* of 14 children alone and never give up on one of them.

GOD BLESS YOU;

To my late father, GOHOU, Maurice Niansoit:

For the path of life you showed me;

To my late Grand Father, GOHOU, Gaston Logoué Niansoit:

For his inspiring legacy;

To HARRIXEL, EMERIC, MAEVA, my children; and ALICE, my wife:

Without your patience and support, this quest would have been unreachable.

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1 Introduction

In the economic development literature, much has been written about poverty reduction in developing countries. In particular, the question of how to improve the welfare of the rural population, has been the origin of several papers. However, little attention has been devoted to the impact of these policies at the farmer's level. In this study, we take a step forward toward bridging this gap by focusing attention on how commodity market reforms impact the farmer's welfare through the price he receives for his production.

The debate over whether globalization should be pushed further in developing countries has been in the forefront of development discussions in recent years. Besides aid flow and diverse technical assistance received by poor countries, it is widely believed that trade liberalization may be a solution to reducing poverty. In the last two decades, a wave of trade liberalization has swept across many developing countries with mixed results. Domestic trade liberalization or market liberalization, as I will refer to it the rest of the paper, is the reduction of the role played by the government in the domestic commodity market. In this market, more responsibility is placed on the private sector. This market liberalization implies that, in poor countries especially, reforms have to be implemented in one of their most important markets: the commodity market.[1] These markets

[1] Akiyama, Baffes, Larson and Varangis (2003) for an extensive survey of the literature on

are important to these countries mainly because a large share of their population depends on commodities for a living. Furthermore, export revenue from these commodity goods typically represent more than half of the total export revenue of the country.[2]

Prior to the reforms, government interventions in these markets were due to several reasons, including: (i) the belief that the government should be the key force driving economic development (Lewis 1954, Hirschman 1958); (ii) the taxation of this sector was easy, and taxes were used to finance state-budget, industrial and urban development; (iii) the importance of these markets to the country's economy were too vital to leave it in the hands of the private sector; and (iv) the price stabilization effect protected farmers from international price volatility. Reforms were prompted in the mid-1980s after the collapse of most of the commodity good prices in the international market. The world price collapse shed light on the mismanagement of the commodity market and countries had to liberalize the market with the assistance of the international development agencies.

Before further elaboration, I need to clarify what regulated and liberalized markets for a commodity good means in this study. Regulated markets in developing countries are characterized by the pres-

commodity market reforms in Africa.

[2] In 1997 for instance, agriculture export revenue as a share of total government export revenue was 93% in Malawi, 88% in Cote d'Ivoire, 87% in Cambodia, and 64% in both Indonesia and Benin.

ence of heavy government marketing boards that legally control the purchase, sale, export or import of agricultural commodities. These marketing boards were established to allow the government to control the commodity price and to tax the agricultural sector to subsidize industrialization. At the beginning of each agricultural season, the marketing board fixed a pan-seasonal[3] and pan-territorial[4] single price. The difference between the international price and the price offered by the board mainly includes the export tax, the stabilization funds, and the marketing board profit. In theory, the export tax goes directly to the government budget, while the stabilization funds is used to guarantee a minimum farmer's price in case of an international negative price shock, and the profit is used to develop the commodity sector. In practice, almost all of the surplus (stabilization and profit) has been used to primarily finance the urban and industrial sectors' development, when its management was sound.

The objective function of these boards was to maximize revenue when selling the commodity on the world market. The combination of the subsidies paid to farmers in remote areas,[5] the high transport cost of the commodities from these remote areas, the management and mismanagement of the boards and the decreasing real world

[3] Pan-seasonal means that the commodity price is the same during all marketing seasons.

[4] Pan-territorial means that the commodity price is the same for all the regions of the country. This implies that farmers in remote areas of the country may receive subsidies for their supply. Also, this pricing scheme led to higher crop production than under the liberalized market.

[5] due to pan-territorial pricing.

commodity price result in unsustainable government budget deficits. With the assistance of the international development agencies, agricultural marketing reforms were initiated to reduce the role of the government and to encourage greater private sector participation. In certain cases, state-owned marketing boards remained in the marketing system with a different and clear mandate: maximization of profits, as does the private sector (Barrett and Mutambatsere, 2005). The implementation of these reforms leads to the liberalized commodity market. So, market liberalization in this paper refers to the reduction of the government's role in the internal commodity market, coupled with a greater role to the private sector.

The results of these reforms have been mixed. The objectives from the reforms were not clear since most of them were preceded by crises (Akiyama et al, 2003). In addition, when the goals of the reforms were defined, they were difficult to measure. However, the principal objective of these reforms was to increase the price that farmers received for their production. This objective was expected to be achieved through a higher share of the world price for the farmers, and a reduction of the marketing board or private sector profit. Other objectives of these reforms were to obtain a change in the regional distribution of price, increase output, higher price volatility,[6] and more private sector intervention in the market to

[6] Higher price volatility was expected to benefit farmers, especially during positive shocks.

finally achieve an increase in farmers' welfare. Basically, more competition and lower transaction costs should have made the farmers better off; however, this may only be half of the story.

Chapter two of this dissertation presents a model of commodity market liberalization that analyzes the impact of market liberalization on the farmer's price. This monopsony-type model includes three main features often studied separately in the literature: spatial competition among buyers, transaction costs, and the international environment. The model replicates the mixed results observed following a commodity market liberalization. It also highlights the fact that the outcome of a commodity market liberalization is ambiguous, unless the three features listed above can be controlled.

The empirical model developed in chapter three is slightly related to the theoretical model and to Pinske et al (2002). It is one of the few models that takes advantage of the recent developments in the field of spatial econometrics, the availability of household survey data, and geographical information data. These recent findings aid in the analysis of the market reforms in developing countries. I combined comprehensive two-period panel household data with a set of geographical information data. The survey data, I use, covers the same households before and after the rice market liberalization in Vietnam.

Vietnam is a good example of commodity market reforms in the

food sector. Before the country implemented its reforms and liberalized the rice sector in the late 80s, it was a net importer of rice. By 1997, the country had become to be the second largest exporter of rice after Thailand. The country successfully implemented economic reforms and the results were reflected in the high average annual economic growth rate (7%) between 1990 and 2000. Agriculture, specifically rice export, also increased robustly during this period. Poverty incidence, especially, fell drastically between these periods.

The empirical model tests for price competition and transaction costs among buyers. Buyer's competition means that buyers are competing for farmer's production. Then, a high level of competition at the buyer's level means that farmer receives a higher price for his/her production. The results show the presence of price competition during the two market regimes. In addition, the results show less competition after the market liberalization. The structure of the market, the level of infrastructure, and the low education level of the farmer are good candidates to explain price competition reduction under market liberalization. Regarding transaction costs, proportional transaction costs decrease after the market liberalization, while fixed transaction costs do not affect the farmer's price during both market regimes. Overall, in the case of Vietnam, one can say that liberalization of the rice sector seem to have improve

farmer's welfare.

The remainder of the dissertation is organized as follows. Chapter two presents a model of commodity market liberalization. This chapter discusses the farmer's price behavior following market liberalization under spatial competition, transaction costs, and the international environment. An empirical model is developed in chapter three to analyze the impact of market liberalization on the farmer's price. This model is tested with data from a comprehensive two-period panel household survey from Vietnam.

2 A model of Commodity Market Liberalization.

2.1 Introduction

The literature on the impact of trade liberalization on farmers' welfare is ubiquitous[7] but, overall, the answer is unclear. The improvement of the farmer's price through liberalization was understood as if more private sector involvement in the commodity market meant more competition, and therefore a reduction of transaction costs. Competition was then defined by the number of private firms in the commodity market, and the share of the international price received by the farmers.

As a result of the commodity market liberalization, private sector entry was massive, especially where the barriers to entry were low. In a 2000 survey of the middlemen in the rice sector in Vietnam, Hai (2002) found that among the group of entry barriers[8] in the rice market, only the lack of capital was cited as the main constraint to entering the market. However, massive market entry by the private sector may not be a sign of higher competition (Barrett, 1997) with regard to the market structure.

[7] At least four different methodologies have been used so far in the literature to analyze the impact of trade liberalization on poverty, including cross-country regression (Dollar and Kraay, 2001), general-equilibrium simulation models (Harrison, Rutherford and Tarr, 2000), micro-macro simulation models (Hertel et al, 2003) and the partial-equilibrium/cost-of-living analysis (Deaton, 1989; Ravallion, 1990; Levinsohn, Berry, and Friedman, 1999).

[8] lack of capital, lack of rice supply, unstable output market, high taxes, licences

Poor infrastructure in developing countries makes transaction costs an important component of the price received by the farmer. Transaction costs have been used to explain the labor market supply in rural areas (Eswara and Kotwa 1986, Sadoulet, De Janvry and Benjamin 1998), the land market (Skoufias, 1995), the supply response and food market (Varangis and Schreiber, 2001, and McIntire and Varangis, 1999). Nevertheless, few papers focused on the link between transaction costs and the farmer's price or welfare.

From the methodological perspective, the literature has three main shortcomings. Firstly, market structure is not well integrated into model. As Agenor and Montiel (1996) argue, focusing on developing countries[9] does not mean that economic agents are different from the ones in the industrial countries, but simply that they evolve in a very different environment (imperfect information, weak market power, poor infrastructure). Secondly, by putting the spotlight on the buyers' price (or private sector) competition, those who should be the final beneficiaries (farmers) of these reforms are not taken into account in the analysis. Finally, the burden of the transaction cost, which shifted from the government to the individual farmer, is often ignored and it is an important component analyzing the impact of liberalization.

[9] The economies of the developing countries are called dual economy because they have two separate economic systems that coexist: a modern sector that is like advanced economies; and a traditional sector that has circuits of production and (formal and/or informal) exchanges.

This chapter offers an analysis of the impact of commodity market liberalization on the farmers' price using a monopsony-type model. In addition to spatial competition, commodity market liberalization makes domestic prices more vulnerable to the international price. If liberalization occurs while the international commodity price has a positive trend, then its impact on the farmer's price may be positive; otherwise, it may be negative. Hence, the timing of the liberalization[10] is crucial. Finally, the model takes into consideration transaction costs, which were paid collectively before liberalization and may now increase the financial burden of the farmer, thus reducing the price he received for his production. Price competition is evaluated at the farmer's level. The level of competition before and after liberalization is analyzed and the effect of transaction costs on the farmer's price is also evaluated.

This chapter extends the present literature in two ways. First, it is an attempt to formally explain, on theoretical grounds, the mixed results observed in the empirical literature. Second, it includes features that were discussed separately in the literature. In particular, the three main features of my model are spatial competition among buyers, transaction costs, and international environment. Besides all of the institutional framework, these three features are key elements to understanding the liberalization phenomenon. Indeed, lib-

[10] which means that at the time of the liberalization, world price trend is positive or negative. The timing is good if the trend is positive, and the timing is bad otherwise.

eralization may increase competition among buyers, but transaction costs may also increase thereby leaving the final effect ambiguous. If we look at the timing of liberalization, we can understand why liberalization may or may not be beneficial when the international price is moving in one direction or another.

The model is designed in the following steps. The overall framework of the model is presented in section 2. The first step, in section 3, models the farmer's supply response to a price offer received by the buyer. Once the buyer knows the farmer's supply response, he will design a price scheme to offer to the farmer to obtain his optimum level of output to be sold on the international market (section 4). Finally, section 5 provides the last step of this model focusing on how the buyer takes into consideration the international commodity price behavior when he sets up the farmer's price. The effect of the commodity market liberalization, in terms of the farmer's price change, is evaluated in the last section.

2.2 Framework of the Model

The objective of this model is to analyze the farmer's commodity price behavior following the market liberalization in the presence of world price variability, transaction costs and spatial competition. The framework of the model is the following: Consider a country divided into a finite number of markets, representing geographical

areas of this country. Each market (or planted area) is composed of a continuum of agricultural households (or farmers), uniformly distributed with a density $F(T)$[11] and has a unique buyer. Farmers produce a commodity good (staple crop), which can be auto-consumed, sold within the country or exported to the world market through an exporter (or buyer). For simplicity, farmers do not participate in international trade.[12] In addition, farmers are small enough to be price-takers and receive a risk-free price of the commodity from the buyer at the beginning of the planting season and then decide their level of production and supply.

The model has two periods. In the first period, the commodity market is regulated by the government, and all buyers are the State Owned Enterprises (SOEs), depending on the government marketing board. Under the regulated market of the first period, the government bears the international price variability and supports transaction costs. In the second period, the government liberalizes the domestic commodity market, and private buyers enter the market. The private buyers compete for market shares through the price they offer to the farmer for his commodity. For simplification, all buyers in the country are identical. Each buyer has monopsonistic

[11] T is the radius of the market that is supposed to be circular. This is explained in detail later on.

[12] They cannot export their production, which is done only by the buyers by assumption (this does not change the main results if lifted).

power on a circular market (Capozza and Van Order 1978)[13] of radius T and faces international price variability of the commodity.[14] A key feature of this model is the spatial competition among buyers after market liberalization occurred, and the presence of transaction costs.

2.3 Farmer's Supply Response.

This section discusses the farmer's commodity production and supply function response when a buyer offers him a price p^f. Assume that farmer i's utility function u depends on the consumption of two goods: a composite of numéraire good,[15] h_i, and an agricultural commodity or staple crop, c_i. The staple crop, when produced in quantity q_i, can be either auto-consumed and/or sold to the buyer. At the beginning of each planting season, the buyer (marketing board or private buyer) informs the farmer i of the net unit price p_i^f he will receive for his production. Indeed, the net unit price received by the farmer can be written $p_i^f = p^f - st_i$, where p^f is the unit price of the commodity offered by the buyer at his doors and s is the cost to transport one unit of output one unit of distance, and t_i is the

[13] "Circles will not cover a plane while hexagons will; however, the analysis of hexagonal market area is not materially different. Extension to hexagonal areas is straightforward and assumption of circular market areas simplifies the investigation." see also footnote 23.

[14] Another way to understand the circular market is to follow the conventional spatial theory and assume that spatial competition occurs in n directions. Since buyers are identical, a given buyer's market size in one direction will be equal to the size in all other directions, say T (Sexton, 1990). If we assume in addition that n is infinite then we have the circular market.

[15] In other words, h_i represents the monetary value of all the goods, other than the staple crop.

distance between the farmer and the buyer. The farmer then decides the quantity of the commodity to produce, $q_i = q(p_i^f)$, to consume, c_i, to use as an input, x_i and to sell, m_i. The farmer can sell a share of his production to the buyer ($m_i > 0$); be self sufficient, ($m_i = 0$); or buy the commodity for his own consumption ($m_i < 0$).

Knowing that he will receive p_i^f as the commodity's price, what will be the farmer's supply function? Farmer i's goal is to maximize his utility

$$u(c_i, h_i; z_u) \tag{1}$$

subject to

$$(p^f - st_i)m_i + h_i + B_i = 0 \tag{2}$$

$$q_i - x_i - m_i - c_i = 0 \tag{3}$$

$$G(q_i, x_i; z_q) = 0 \tag{4}$$

where $c_i, q_i, x_i \geq 0$; B_i is an exogenous transfer or other income, G is the production technology and z_u and z_q represent all the other parameters in the utility and production technology functions. The second constraint (2) represents the cash constraint and states that expenditures must not exceed revenues; the resource constraint (3) means that the quantity of the good produced, q_i, must equal the quantity used as input, x_i, the quantity sold, m_i, and the quantity consumed c_i. The last constraint, (4), is the production technology

function that links inputs to output.

The solution of this problem is straightforward. Using μ_i, ϕ_i, and λ_i as the Lagrangian multipliers, the Lagrangian of the problem is:

$$L = u + \mu_i(q_i - x_i - m_i - c_i) + \lambda_i(p_i^f m_i + h_i + B_i) + \phi_i G \tag{5}$$

and the first order conditions for consumption ($c_i > 0$), input ($x_i > 0$), and production ($q_i > 0$) are[16]

$$\frac{\partial u}{\partial c_i} - \mu_i = 0 \tag{6}$$

$$-\mu_i + \phi_i \frac{\partial G}{\partial x_i} = 0 \tag{7}$$

$$\mu_i + \phi_i \frac{\partial G}{\partial q_i} = 0 \tag{8}$$

Since the farmer's price is exogenous to the farmer, the solution can be written as that a separable model (producer-consumer) in the following steps: (i) profit maximization under technology constraint; (ii) utility maximization subject to income constraint. The profit maximization constraint is such as:

$$\underset{q_i, x_i}{Max}(\pi_i) = (p^f - st_i)(q_i - x_i) \tag{9}$$

subject to (4) . Using the Lagragian as above $L = (p^f - st_i)(q_i - x_i) + \phi_i G$

[16] Notice that knowing the values of consumption c_i, input x_i, and production q_i, allows us, using equation (3) to calculate the value of the traded good m_i.

and the first order conditions are:

$$\frac{\partial L}{\partial q_i} = (p^f - st_i) + \phi_i \frac{\partial G}{\partial q_i} \tag{10}$$

and

$$\frac{\partial L}{\partial x_i} = -(p^f - st_i) + \phi_i \frac{\partial G}{\partial x_i} \tag{11}$$

The solution of the equations system (10) and (11) give the farmer supply function, $q_i = q_i(p_i^f; z_q)$, and $x_i = x_i(p_i^f; z_q)$. The utility maximization under the income constraint $p_i^f c_i = y = p_i^f(q_i - x_i) + B_i$ yields the consumption level as $c_i = c_i(p_i^f, y, z_u)$.

The farmer's supply function of the commodity, which can be both consumed and traded, has two main properties: non linearity and asymmetric response to price. The non linearity property means that there is a minimum price, say $p^f_{\min}$, under which the farmer will not supply the buyer. In this case, the farmer may produce or buy the commodity for his own consumption. An asymmetric response to price occurs when the magnitude of the net response of supply to the price decline is less than the magnitude of the net response to the price increase. Indeed, if the farmer's price increases, two effects are at play. First, farmers will increase production along the static supply curve, and second, the price increase will lead to a shift of the linear supply curve as new technologies (or new investments) are used. When the price decreases, technology may not be undone,

thus the supply response will be only along the new static supply curve.[17]

Farmer i's supply function is $q_i = q(p_i^f) > 0$ if $p_i^f > p_{\min}^f$ and $q_i = 0$ if $p_i^f \leq p_{\min}^f$. I assume that all farmers have the same supply function $q(.)$, continuous, monotically increasing and at least a twice differentiable function of the farmer's price.[18] The aggregate commodity supply by farmers on one buyer's market is then:[19]

$$Q(p^f, T) = \int_{market} q(p^f - st_i)dF = 2\pi \int_0^T F(t)tq(p^f - st)dt$$

Notice that there is no index i in the last equation since the integral is done for all farmers located at distance t from the buyer. Figure 1 displays the production, the demand, and the supply functions of a farmer. A clear distinction is made between the farmer's production and supply. If the price P^f is too low ($P^f < P_0^f < P_{\min}^f$), the farmer will not produce and will buy the commodity on the market for his own consumption (demand part of the graph), and in this case, demand is positive and supply is zero. At an intermediary price ($P_0^f < P^f < P_{\min}^f$), the farmer will produce the autarky

[17] These 2 effects, especially the asymmetric response, may applied to multi year crop such cocoa and coffee, but not necessarily to one year/season crop such as rice.

[18] The supply function is positive on the interval $[P_{\min}^f, +\infty)$ and zero between $[0, P_{\min}^f)$, where $P_{\min}^f$ is the minimum price at which the farmer supplies a positive quantity of good to the market.

[19] The market is the area of a disk of radius T. Farmer i production is $q_i = q(p^f - st_i)$. Then the total production on the circle of radius t is $q_t = 2\pi t q_i$, where q_i is the production of each farmer located at distance t from the buyer. Total production supply on the market of radius T is $Q(p^f, T) = 2\pi \int_0^T tq(p^f - st)dt$.

level ($Q_{autarky}$), demand is zero and supply is still zero. When the farmer's price is above a minimum price ($p^f_{\min}$), there is an incentive for the farmer to produce and production is then above the autarky level and supply is then positive.

Proposition 1 *: If the individual supply function is concave and the radius of the market is a linear function of the farmer's price, then the aggregate supply function is also concave and displays the asymmetry response property.*

Proof. : Concavity of the aggregate supply function.

The aggregate supply function is defined by

$$Q(p^f, T\left(p^f\right)) = 2\pi \int_0^{T\left(p^f\right)} tF(t)q(p^f - st)dt \tag{P1}$$

To show that $Q\left(p^f, T\left(p^f\right)\right)$ is concave with respect to p^f, we just have to show that the second derivative of $Q\left(p^f, T\left(p^f\right)\right)$, with respect to p^f, is negative. I use the Leibnitz's rule[20] to calculate this derivative. The first derivative of Q is:

$$\frac{\partial Q\left(p^f, T\left(p^f\right)\right)}{\partial p^f} = TF(T)q(p^f - sT)\frac{\partial T}{\partial p^f} + \int_0^{T\left(p^f\right)} tF(t)q'(p^f - st)dt \tag{P2}$$

Since $q()$ and $\frac{\partial T}{\partial p^f}$ are positive, the first derivative of Q is also positive, which means that aggregate supply is a not a decreasing function of

[20] The leibnitz 's rule states that
$\frac{\partial}{\partial z}\int_{a(z)}^{b(z)} f(x,z)dx = f(b\left(z\right),z)\frac{\partial b(z)}{\partial z} - f(a\left(z\right),z)\frac{\partial a(z)}{\partial z} + \int_{a(z)}^{b(z)} \frac{\partial f(x,z)}{\partial z}dx$

the farmer's price. The second derivative of the aggregate supply is then:

$$\frac{\partial^2 Q}{\partial (p^f)^2} = TF(T)\left[q'\frac{\partial T}{\partial p^f} + q\frac{\partial^2 T}{\partial (p^f)^2}\right] + TF(T)q'\frac{\partial T}{\partial p^f} + \int_0^{T(p^f)} tF(t)q"(p^f - st)dt \tag{P3}$$

Rearranging the terms in (P3) leads to:

$$\frac{\partial^2 Q}{\partial (p^f)^2} = 2TFq'\frac{\partial T}{\partial p^f} + q\frac{\partial^2 T}{\partial (p^f)^2} + \int_0^{T(p^f)} tF(t)q"(p^f - st)dt \tag{P4}$$

In the special case of uniform density function $F(t) = \rho$, where ρ is a constant, and $\frac{\partial^2 T}{\partial (p^f)^2} = 0$, we have (using the integral by parts property)

$$\begin{aligned} \frac{\partial^2 Q}{\partial (p^f)^2} &= 2T\rho q'\frac{\partial T}{\partial p^f} - \frac{\rho T}{s}q' + \frac{\rho}{s^2}\left(q(p^f - sT) - q(p^f)\right) \\ &= T\rho q'\left[2\frac{\partial T}{\partial p^f} - \frac{1}{s}\right] + \frac{\rho}{s^2}\left(q(p^f - sT) - q(p^f)\right) \end{aligned} \tag{P5}$$

Since $q[p^f - sT] - q[p^f] < 0$ and $q'[p^f - sT] > 0$, $\frac{\partial^2 Q(p^f, T(p^f))}{\partial (p^f)^2} < 0$ if and only if $2\frac{\partial T}{\partial p^f} - \frac{1}{s} < 0$, which is equivalent to $\frac{\partial T}{\partial p^f} < \frac{1}{2s}$. Notice that under a regulated and liberalized market $\frac{\partial T}{\partial p^f} \geq 0$ then using equation (17), it is obvious that $\frac{\partial T}{\partial p^f} < \frac{1}{2s}$ and the aggregate supply is also concave. It then has the asymmetry response properties like the farmer's supply function. ■

Once the farmer's supply response is known, the next step is to analyze how the buyer will set up the price he will offer to the farmer

to reach his desired output level. The next section first discusses the price formation under a regulated market and then focuses on the liberalized market regime. It is important to make this distinction since the buyer's maximization program is different for each market regime. In the regulated market, the buyer is the government and in the liberalized one, the buyer is the private sector. Since the monopsonist is the only buyer of the output, the price p^f, he offers, must not be viewed as exogenous. Each buyer buys the commodity from all farmers on his market and sells it on the world market. The buyer is in the middle of his market and, transportation costs from the buyer to the port are assumed to be zero for simplification and without loss of generality.[21]

2.4 Farmer's Price Formation

When the buyer is setting the farmer's price, an important element to take into consideration is the nature of the market in which the price is decided. Buyers are different depending on the market regime. The buyer is a public body under the regulated market while it is a private firm/agent in liberalized regimes. Depending on the market regime, the buyer's objective function will be different. The following paragraphs discuss how the buyer sets up the farmer's price depending on the market regime.

[21] In the empirical model, each buyer will be located at different ports within the country.

Regulated Market: Under the regulated market, the SOE, through the marketing board is the only buyer. In this regime, the objective function of the SOE is to maximize profit subject to: (i) keep most of the farmers in business; and (ii) avoid asking for subsidy to the government. The first constraint is due to the social role of the government. Since most of the population is living in the rural area, keeping most the farmers in business is a form of income redistribution. The second constraint means that the government will let the very high cost farmers go out of business. Several methods may allow the SOE to solve its maximization problem. Empirical evidences show that the SOE offers the same price to all farmers in business and pays for the transport cost of the commodity. I will also assume this solution here.

In this market regime, a State Owned Enterprise (SOE) is the buyer in any given market. Buyers do not compete since the government fixes a uniform farmer's price and the market size for each buyer (or SOE). Hence, the market size for each buyer is independent of the farmer's price i.e. $\frac{\partial T}{\partial p^f} = 0$. In this case, there is no spatial competition.

The buyer faces an increasing commodity supply curve that relates p^f to the total domestic production Q^d. Since the price offered is the same for all farmers, the production of farmer i is then independent of the distance between the farmer and the buyer. The

profit made by the buyer on farmer i is then: $\Omega_i = p^w q_i(p^f) - c_i(q_i)$ where $c_i(q_i) = p^f q_i(p^f) + st_i q_i(p^f)$ is the cost of purchasing output $q(p^f)$ from farmer i, p^w is the exogenous world price of the commodity, p^f is the commodity's price at the buyer's doors, and st_i is the transaction cost that is assumed to be only the transportation cost[22], s is the cost to transport one unit of output one unit of distance, and t_i is the farmer-buyer distance. The aggregate profit of the marketing board on a circle of radius t is then $\Omega_t = 2\pi t\Omega_i$, where Ω_i is the profit function from farmer i located at distance t_i from the buyer. Thus, the total profit function of the buyer on his whole market of radius T is then:

$$\Omega = \int_0^T \Omega_t dt = \int_0^T 2\pi t\Omega_i dt = \pi T^2 q(p^f)\left(p^w - p^f - \frac{2}{3}sT\right) \qquad (12)$$

Notice that $Q(p^f, T) = \pi T^2 q(p^f)$ is[23] the aggregate output purchased by the marketing board on its market and $\frac{2}{3}sT$ is the average transport cost per farmer. Indeed, the total unit cost for all farmers in the market of radius T is $\int_0^T (2\pi tst)dt = \frac{2}{3}\pi sT^3 = \pi T^2(\frac{2}{3}sT)$, where πT^2 is the area measure of the market and $\frac{2}{3}sT$ represents the average unit cost per farmer. Since there is no spatial competition,

[22] For simplification, I assume that the transport cost is the only proportional transaction cost (PTC), and fixed transaction costs (search cost, bargain cost,...) are assumed to be equal to zero.

[23] I can also rewrite $Q(p^f, T) = \pi T^2 q(p^f) = Aq(p^f)$ where $A = \pi T^2$ is the market area of the buyer and $q(p^f)$ is the average production of the farmers in this market. The assumption of a circular market can now be easily lifted. If the market is square-shaped with length a, total production will be $Q(p^f, T) = Aq(p^f)$ where $A = a^2$. The same logic holds.

each buyer or "marketing board" will then maximize its profit with respect to p^f. The first order condition (FOC) $\frac{\partial \Omega}{\partial p^f} = 0$ yields

$$p_R^f = p^w - \left(\frac{Q(p^f, T)}{\frac{\partial Q(p^f, T)}{\partial p^f}} + \frac{2}{3} sT \right) \tag{13}$$

where p_R^f is the price received by the farmer.[24] The net price received by farmer i is also $p_{Ri}^f = p_R^f$. The term on the right hand side (RHS) of equation (13), in parentheses, is the mark-up price. The term $\left(\frac{\partial Q(p^f, T)}{\partial p^f} \right)$ captures the supply effect of the price change, and $(\frac{2}{3} sT)$ is the average unit transport cost paid by the buyer for one unit of the commodity. It is easy to see this average transport cost as a redistribution mechanism. Indeed, farmers located up to $\frac{2}{3}T$ of the market radius, pay a "tax", which is used as a "transport subsidy" for farmers located between $\frac{2}{3}T$ and T. In the regulated market, farmers located far away from the buyer stay in business mainly because they received a subsidy from the government.

Liberalized market: In the liberalized market, buyers are private agents and their objective function is different from the SOEs. Two main differences exist between the liberalized market and the reg-

[24] This result of transport costs supported by all the farmers is corroborated by the real life examples in the developing countries. To reduce regional disparities (generally between the capital city that is most of the time on the coast and the other regions of the country), governments in developing countries put a transport tax on the commodity's price such that the price of the commodity is the same throughout the country. For instance in the Ivory Coast, the retail price of gas in Abidjan (the capital), where oil is refined, is the same as in the north of country (about 500 miles away), which imports the gas from Abidjan.

ulated one. Firstly, each farmer receives a different price for his production, mainly because transport costs are supported this time by the farmers. A farmer i receives a net price $p_i^f = p^f - st_i$ for one unit of his production,[25] where p^f is the commodity price at the buyer's doors. Secondly, buyers can compete for market size. In the liberalized market regime, each market has a private buyer with monopsony power. However, due to spatial competition, each buyer can increase his market size only by offering a higher farmer's price than his neighbor and therefore $\frac{\partial T}{\partial p^f} > 0$. Even though questions regarding the optimal number of buyers and their optimal locations are interesting issues, they will not be addressed here, and they do not affect the main results of the model.

When offered a price p_i^f, farmer i, located at the distance t_i from the buyer, produces a quantity $q_i = q(p_i^f)$ of the commodity. Total cost supported by the buyer is $p^f Q(p^f, T)$. The buyer's gross revenue,[26] following the sale to the world market, is $G(Q)$. The buyer[27] will choose p^f to maximize his profit, which is given by

$$\pi = G(Q(p^f, T(p^f))) - p^f Q(p^f, T(p^f)) \tag{14}$$

[25] Another way to present the net price is to assume that the buyer offers the same farmer's price to all farmers in his market and farmers pay for the delivery cost of their production.

[26] I assume gross revenue for simplicity. This assumption can be lifted without changing the main results.

[27] Following the discussion on farmer output supply, the buyer can obtain any amount of output, $Q(p^f, T)$ by offering the right level of the farmer 's price, p^f. The supply response, $q(p^f - st_i)$, of the farmer is positively correlated to p^f. This will rule out the condition under which the buyer buys an infinite level of output.

The first order condition is then

$$G^{'}(Q)\frac{\partial}{\partial p^f}\left[Q(p^f,T(p^f))\right]=Q(p^f,T(p^f))+p^f\frac{\partial}{\partial p^f}\left[Q(p^f,T(p^f))\right] \qquad (15)$$

The left hand side (LHS) of equation (15) is the total marginal gross revenue (MGR) of the buyer. It is the product of the marginal revenue, $G^{'}(Q)$, due to the purchase of one additional unit of Q and the additional units of the commodity, $\frac{\partial}{\partial p^f}\left[Q(p^f,T\left(p^f\right))\right]$, bought by the monopsonist due to the change of the farmer's price p^f. The RHS is the total marginal cost (MC) of the commodity bought when an extra unit is purchased. It has two components: (i) $Q(p^f,T)$, which is the additional cost if the farmer's price is raised by one unit; and (ii) $p^f\frac{\partial\left(Q(p^f,T\left(p^f\right))\right)}{\partial p^f}$, which is the cost of the additional units of the commodity bought due to a change of the farmer's price.

If the buyer resells the commodity to the world market at a unit price,[28] $p^w(Q^w)$, then, $G(Q^d)=p^wQ^d$ and the FOC (15) becomes

$$p^f=p^w-\frac{Q(p^f,T(p^f))}{\frac{\partial Q}{\partial p^f}+\frac{\partial Q}{\partial T}\frac{\partial T}{\partial p^f}} \qquad (16)$$

The second term on the RHS of (16) is also the mark-up price, as in equation (13). The first component of its denominator, $\left(\frac{\partial Q}{\partial p^f}\right)$, captures the supply effect due to a change of the price offered to the

[28] I assume that p^w in the static model is exogenous and constant. This assumption is lifted later on.

farmers. The spatial competition among monopsonists is captured by the second component of the denominator, $\left(\frac{\partial Q}{\partial T}\frac{\partial T}{\partial p^f}\right)$. Then, the private buyer will offer a unit price p^f at his doors, while the farmer i will receive a net price $p^f - st_i$.

The derivative $\frac{\partial T}{\partial p^f}$ can be seen as the spatial competition index. A farmer, located at the border of two markets, A and B, will be indifferent between selling his production to buyer A or B, if the net price he receives from each of them is the same. If the distance between A and B is M; and the price offer by A is $p_i^f = p^f - sT$ while B offers $\widehat{p_i^f} = \widehat{p^f} - s(M-T)$. Then the indifference equation for the farmer is: $p^f - sT = \widehat{p^f} - s(M-T)$. It implies that $T = (2s)^{-1}\left(p^f - \widehat{p^f} + sM\right)$. Then, the market size radius of a buyer is a function of transportation costs, distance between buyers, and the gap between his own price and the neighboring buyer's price. It follows that:

$$\frac{\partial T}{\partial p^f} = \frac{1}{2s}\left(1 - \frac{\partial \widehat{p^f}}{\partial p^f}\right) \tag{17}$$

Equation (17) expresses the buyer's belief about the price response of the neighboring buyer to his own price change. Therefore, a liberalized market means that $\frac{\partial \widehat{p^f}}{\partial p^f} < 1$.[29] Let's $\alpha = \frac{\partial T}{\partial p^f}$, then the net

[29] When $\frac{\partial \widehat{p^f}}{\partial p^f} = 0$, we are in the case of Hotelling-Smithies spatial competition where there is no reaction from the neighboring rival following a price change. In this spatial competition case, each buyer assumes that the prices of his competitors are fixed, thus $\frac{\partial T}{\partial p^f} = \frac{1}{2s}$

price received by farmer i in the liberalized regime is:

$$p_{Li}^{f} = p^{w} - \frac{Q(p^{f}, T)}{\frac{\partial Q}{\partial p^{f}} + \alpha \frac{\partial Q}{\partial T}} - st_{i} \tag{18}$$

Several factors, besides the quantity produced, can increase the farmer's price under the liberalized market. These factors include a favorable international environment (higher p^{w}), a higher competition among buyer $\left(\alpha \frac{\partial Q}{\partial T} \text{ is higher}\right)$, and a reduced transport or transaction cost (lower s).

A regulated market means that $\frac{\partial \widehat{p^{f}}}{\partial p^{f}} = 1$. This is equivalent to a Loschian spatial competition,[30] which means that any price change made by a buyer is expected to be matched by its neighboring rival. The main difference between the regulated and liberalized market regime, besides spatial competition, is the net price received by the farmer. In the regulated regime, the farmer's price is net of the constant average transport cost, while in the liberalized regime the farmer's price is net of the individual transport cost.

I can lift the zero transportation cost from the buyer to the port and obtain similar formulas as follows. Assume that the cost function of the buyer, besides the purchase of the farmer's production, is $c(Q) = p^{f}Q + m(Q) + f$ where $m(Q)$ is the transport cost to

[30] In a Loschian competition, each buyer assumes his market size to be fixed and sets the farmer's price as a monopoly (Capozza and Van Order, 1979), then $\frac{\partial T}{\partial p^{f}} = 0$. This type of competition can be seen as the spatial equivalent of a noncompetitve oligopoly.

the port and f is a fixed cost. The profit function of the buyer when selling his purchase Q to the international market is $\pi = p^w Q(p^f, T(p^f)) - c(Q(p^f, T(p^f))$ where p^w is the international price of the commodity. The first order condition $\frac{\partial \pi}{\partial p^f} = 0$ can be written as (16)

$$\frac{\partial \pi}{\partial p^f} = p^w \left[\frac{\partial Q}{\partial p^f} + \frac{\partial Q}{\partial T} \frac{\partial T}{\partial p^f} \right] - Q - (p^f + \frac{\partial m}{\partial Q}) \left[\frac{\partial Q}{\partial p^f} + \frac{\partial Q}{\partial T} \frac{\partial T}{\partial p^f} \right] = 0 \qquad (19)$$

$$p^f = (p^w - \frac{\partial m}{\partial Q}) - \frac{Q(p^f, T(p^f))}{\frac{\partial Q}{\partial p^f} + \frac{\partial Q}{\partial T} \frac{\partial T}{\partial p^f}} \qquad (20)$$

and writing $\widehat{p^w} = p^w - \frac{\partial m}{\partial Q}$ gives exactly the same formula, as if the transport costs were zero. $\widehat{p^w}$ is then the world price of the commodity net of marginal non-raw processing costs (Sexton, 1990).

Equations (13) and (18) give the net price received by the farmer in each market regime. For simplification, these equations assume the world price is constant. Before the analysis of the farmer's price change after market liberalization, the last step of the model is to lift the assumption of a constant world price and to analyze its behavior. This is the purpose of the next section.

2.5 Commodity World Price Behavior

This section derives a formal behavior model of the international commodity price based on Sir Lewis (1954), and Deaton and Laroque (2003). A good model of commodity price behavior should replicate

most of the features of these prices. Empirical studies have shown that commodity prices are highly auto-correlated, and display high variability, skewness[31] and kurtosis[32] (Deaton and Laroque, 1996). Two methods are available in the literature to describe the behavior of prices: time-series modelling and the more traditional supply and demand method.

The supply and demand method is used in this paper[33] to analyze the behavior of commodity prices. Commodity prices' autocorrelation can be explained by the demand side, which is auto-correlated. The Lewis' model (1954) is used for the supply side of the model.[34] Assume a partial equilibrium model where the (log of) world demand, d^w, of a tradable commodity is a log-linear function of the (log of) world income, y_t, and of the (log of) world price of the commodity, p_t^w

$$d_t^w = K + Ay_t - Bp_t^w + \varepsilon_t^d \tag{21}$$

[31] Skewness is a measure of the lack of symmetry of a distribution (and any symmetric distribution should have a skewness equal to zero, like the normal distribution). Negative values for the skewness indicate data that are skewed left (which means that the left tail is heavier than the right tail) and positive values for the skewness indicate data that are skewed right (the right tail is heavier than the left tail). The skewness measure is $\mu_3/(\mu_2)^{1.5}$, where μ_r is the r^{th} moment.

[32] Kurtosis is a measure of whether the distribution are peaked or flat relative to a normal distribution. Thus, a distribution with high kurtosis tends to have a distinct peak near the mean, decline rather rapidly, and have heavy tails. A distribution with low kurtosis tends to have a flat top near the mean rather than a sharp peak. The kurtosis measure is $(\mu_4/\mu_2^2) - 3$ where μ_r is the rth moment. The normal distribution has a kurtosis of zero. Positive kurtosis indicates a "peaked" distribution and negative kurtosis indicates a "flat" distribution.

[33] mainly because of data constraint.

[34] Lewis' concern was to explain why the sugar's price relative to imported manufactured goods were constant or decreasing. The solution was an "unlimited supply of labor" that will keep wages down, and producing a cheap commodity under the tropics.

where y_t is a nonstationary integrated process of order 1, I(1),[35] $A > 0, B > 0$, K are parameters, and ε_t^d is a stationary, unobservable random variable. Hence, demand is an increasing function of the world income, and a decreasing function of the commodity's price.

Regarding the supply, the equation is based on Lewis (1954) and does not include the world income since the empirics show that commodity prices are low while world demand and income are increasing. The supply is then

$$s_t^w = s_{t-1}^w + M(p_t^w - p^*) + \varepsilon_t^s \tag{22}$$

where s_t^w is the log of the world supply, M, a parameter and ε_t^d is a stationary, unobservable supply random shock and p^* is the marginal cost of production on the marginal land and is constant following Lewis' assumption of an unlimited labor supply in developing countries. Since the model ignores inventory and competitive storage of the commodity, the equilibrium world price is determined by equalizing the supply (22) and the demand (21), $d_t^w = s_t^w$ then

$$p_t^w = (B + M)^{-1} \left[K + Ay_t + Mp^* - s_{t-1}^w + \varepsilon_t^d - \varepsilon_t^s\right] \tag{23}$$

[35] which means that $\Delta y_t \sim I(0)$.

Plugging p_t^w from eq. (23) into (22) leads to

$$s_t^w = (B+M)^{-1}[MK + MAy_t - MBp^* + Bs_{t-1}^w + M\varepsilon_t^d + B\varepsilon_t^s] \tag{24}$$

which can be written

$$\Delta s_t^w = (B+M)^{-1}[MA\Delta y_t + M(Ay_{t-1} - s_{t-1}^w) + MK - MBp^* + M\varepsilon_t^d + B\varepsilon_t^s] \tag{25}$$

where $\Delta s_t^w = s_t^w - s_{t-1}^w$ and $\Delta y_t = y_t - y_{t-1}$. Using eq. (23), s_{t-1}^w will be

$$s_{t-1}^w = K + Ay_t + Mp^* - (B+M)p_t^w + \varepsilon_t^d - \varepsilon_t^s \tag{26}$$

and moving eq. (26) one period ahead gives:

$$s_t^w = K + Ay_{t+1} + Mp^* - (B+M)p_{t+1}^w + \varepsilon_{t+1}^d - \varepsilon_{t+1}^s \tag{27}$$

Eliminating supply of the previous period by plugging equation (26) and (27) into equation (24) and writing the price as a function of its previous period value and the world income growth yields:

$$p_t^w - p^* = (B+M)^{-1}\left[B(p_{t-1}^w - p^*) + A\Delta y_t + \Delta\varepsilon_t^s - \varepsilon_t^d\right] \tag{28}$$

which leads to

$$p_t^w - p^* = \theta(p_{t-1}^w - p^*) + \alpha\Delta y_t + \mu_t \tag{29}$$

with $\theta = B(B+M)^{-1}$, $\alpha = A(B+M)^{-1}$ and $\mu_t = (B+M)^{-1}(\Delta\varepsilon_t^s - \varepsilon_t^d)$. Equation (29) shows that the commodity price is stationary and its long run value is $\alpha(1-\theta)^{-1}E(\Delta y_t)$. However, in the short-run, price will respond to demand and supply shocks. The commodity world price at time t, p_t^w, is then a function of its previous value (p_{t-1}^w) and of the world income growth Δy_t. Indeed, α is supposed to be positive since an increase of the world price income will push up the demand for the commodity.

The behavior of the commodity world price represents the effect of the international environment and it also captures the effectiveness of the timing of the market liberalization. An increasing world price means good timing for liberalization since the impact of the world price's change on the farmer's price is likely to be positive. However, few governments will liberalize at this moment because of the profit they can easily make in this sector while farmers receive a "regulated" price. In the case of a negative shock of the world price, which represents bad timing for liberalization, the government may decide to liberalize to avoid paying subsidy to farmers, if the regulated price tends to be higher than the world's price.

To come back to our point of interest, the impact of the world commodity price, consider two periods where the regulated market regime is period 1 and the liberalized regime is period 2. The world price p_1^w in period 1 is known and the world price $\widetilde{p_2^w}$ in period 2

is random. In period 1, the buyer has to forecast the world's price in period 2 before he sets the farmer's price. For simplification, I assume that the buyer has a simple forecast function, which is defined as found above[36],

$$\widetilde{p_2^w} = \theta p_1^w + \alpha \Delta y_t + \mu \tag{30}$$

where μ is a random variable such that $\mu \tilde{} N(0, \sigma^2)$ and θ $(0 < \theta < 1)$ is the coefficient of expectation for the future. If the buyers have a high expectation for the second period price, then θ is close to 1, otherwise θ is close to 0. Indeed, in most cases, the buyer will anticipate that liberalization occurs at a bad time, when the world price is likely to decrease, so he will choose θ close to 0. The expected world price in period 2 is then

$$E\left(\widetilde{p_2^w}\right) = \overline{p_2^w} = \theta p_1^w + \alpha E(\Delta y_t) \tag{31}$$

Equation (31) shows that the expected world's price forecasted by the buyer depends on the previous period world's price and the world's growth rate. If the world's economy experiences a positive growth rate, the demand for the commodity may increase and the price will also increase (I assume a constant world's production and a small country case).

[36] I assume $p^* = 0$ for simplification.

The previous four sections explained in detail the determination of the price a farmer receives for his commodity under two different market regimes: regulated and liberalized. Also, the behavior of the world commodity price has been analyzed. The next section will put all these results together and compare the price impact of commodity market liberalization.

2.6 Price Effect of the Commodity Market Liberalization

The objective of this model is to analyze the farmer's price behavior, due to commodity market liberalization and ultimately, evaluate its effects in term of farmers' welfare. An important difference between the regulated and liberalized market regimes is that the transaction costs are shifted from a commonly supported cost, through government intervention, to an individually supported cost by each farmer. In addition, in the liberalized market, spatial competition should push the buyer to offer a higher farmer's price, while in the regulated market, the farmer's price is reduced by the average transport cost.

Under the regulated market regime, all the farmers receive the same price from the government marketing board

$$p_{Ri}^{f} = p_{R}^{f} = p_{1}^{w} - \left(\frac{Q(p^{f}, T)}{\frac{\partial Q(p^{f}, T)}{\partial p^{f}}} + \frac{2}{3} sT \right) \tag{32}$$

where p^f_{Ri} is the net price received by the farmer and p^w_1 is the world price in period 1. Conversely, under the liberalized regime, each farmer receives a different price since he has to support the transportation cost of his production to the buyer's doors, then

$$p^f_{Li} = p^w_2 - \left(\frac{Q(p^f, T)}{\frac{\partial Q}{\partial p^f} + \frac{\partial Q}{\partial T}\frac{\partial T}{\partial p^f}} + st_i \right)$$

where p^f_{Li} is the net price received by farmer i, and $\widetilde{p}^w_2$ is the world price in period 2. If the world price is the same and constant in both regimes ($p^w_1 = p^w_2$), and we consider the farmer's price at the buyer's door, we have

$$p^b_R = p^w - \frac{Q(p^f, T)}{\frac{\partial Q(p^f, T)}{\partial p^f}}$$

and

$$p^b_L = p^w - \frac{Q(p^f, T)}{\frac{\partial Q}{\partial p^f} + \frac{\partial Q}{\partial T}\frac{\partial T}{\partial p^f}} \tag{33}$$

where p^b_R and p^b_L are the commodity prices at the buyer's doors under the regulated and liberalized regimes, respectively. Then,

$$\Delta p^b = p^b_L - p^b_R = Q^d \frac{\frac{\partial Q}{\partial T}\frac{\partial T}{\partial p^f}}{\frac{\partial Q}{\partial p^f}\left(\frac{\partial Q}{\partial p^f} + \frac{\partial Q}{\partial T}\frac{\partial T}{\partial p^f}\right)} > 0 \tag{34}$$

Equation (34) states that the commodity's price under the liberalized market is higher than under the regulated market. In the present case, only prices at the buyers doors are considered. Then, liberalization seems beneficial for the farmers. This result is mostly due

to the spatial competition that happens after the market liberalization.[37]

However, if we consider the net price received by the farmer, with constant world's price under both regimes, the liberalized price is not always higher than the regulated one.[38] Indeed,

$$\Delta p^f = p^f_{Li} - p^f_{Ri} = Q^d \frac{\frac{\partial Q}{\partial T}\frac{\partial T}{\partial p^f}}{\frac{\partial Q}{\partial p^f}\left(\frac{\partial Q}{\partial p^f} + \frac{\partial Q}{\partial T}\frac{\partial T}{\partial p^f}\right)} + s(\frac{2}{3}T - t_i) \tag{35}$$

Since the first term on the RHS of (35) is always positive, the sign of Δp^f depends on the sign and magnitude of $s(\frac{2}{3}T - t_i)$. Farmers located up to 2/3 of the market radius (farmers closed to the buyer) will receive higher net price under the liberalized market while farmers located farther away may receive a lower net price. In this case, the positive spatial competition effect may be reduced or cancelled by the negative transaction cost effect. With two features at play, the result is already ambiguous.

In this benchmark model, with a constant world price in both periods, the immediate effect of liberalization may be negative for farmers located in the remote area, and who are most likely to be poor.

Another way to understand the market regime change effect is to

[37] The only effect, in this case, is the spatial competition effect, which is the only feature at play with a positive outcome in terms of the farmer's price change.

[38] In the regulated market, the price offered by the govenment is also the net price received by the farmers.

look at the mark-up price of these price, $\left(p^w - p^f\right)\left(p^f\right)^{-1}$. Equation (13) and (18) can be rewritten in terms of elasticity by dividing both sides by the farmer's price. Hence, for the regulated market regime,

$$\rho_R = \left(p^w / p^f_{Ri} - 1\right) = \frac{1}{\varepsilon_Q} + \frac{2}{3}\frac{sT}{p^f_R} \tag{36}$$

and for the liberalized market regime,

$$\rho_L = \left(p^w / p^f_{Li} - 1\right) = \frac{1}{\varepsilon_Q + \varepsilon_T \varepsilon_{QT}} + \frac{st_i}{p^f_{Li}} \tag{37}$$

where ρ_R and ρ_L are the mark-up ratios in each market regime; $\varepsilon_Q = \frac{\partial \ln Q}{\partial \ln p^f}$ is the own-price elasticity of the production supply facing the buyer; $\varepsilon_T = \frac{\partial \ln T}{\partial \ln p^f}$ is the elasticity of the market size with respect to the farmer's price and $\varepsilon_{QT} = \frac{\partial \ln Q}{\partial \ln T}$ is the elasticity of the production supply with respect to the market size. In the standard monopsony model, ε_Q is the key to measuring monopsony power,[39] and summarizes the extent to which a buyer may reduce the farmer's price below the competitive level. Incidentally, in this model, perfect competition is not possible since ρ_R, and ρ_L are always greater than 0.

Similarly, I can estimate the mark-up ratio difference between

[39] The degree of monopsony power can be measured by the elasticity of output supply, $\varepsilon = (dQ/dp^f)(p^f/Q)$ with $0 < \varepsilon < \infty$. If $\varepsilon \to \infty$, the output Q market is perfectly competitive and monopsony does not exit. It may be noted that the lower is the value of ε, the higher is the monopsony power (Shieh and Yeh, 2004).

these two regimes

$$\Delta\rho = \rho_R - \rho_L = \frac{\varepsilon_T \varepsilon_{QT}}{\varepsilon_Q \left(\varepsilon_Q + \varepsilon_T \varepsilon_{QT}\right)} + s(\frac{2}{3}\frac{T}{p^f_{Ri}} - \frac{t_i}{p^f_{Li}}) \tag{38}$$

Equation (38) shows that the sign of the mark up ratio difference depends on the transaction cost in terms of the farmer's price in each regime.

In this special case where the commodity world price is the same in both regimes, transaction costs, represented here by only the transport cost, plays an important role. In the regulated market, transaction costs are supported collectively, while in the liberalized one, most of the transaction costs are supported individually, which impacts the net price the farmer receives. This simple special case shows how important transaction costs and spatial competition are when discussing market liberalization.

Now, I will discuss the more general case with a non constant commodity world price. The buyer has to forecast in period 1 what the world's price will be in period 2, using the forecast function displayed in equation (30). The farmer's price under the regulated market is still the same as in equation (32), but the farmer's price under the liberalized market during the second period is now

$$\widetilde{p^f_{Li}} = \widetilde{p^w_2} - \left(\frac{Q(p^f, T)}{\frac{\partial Q}{\partial p^f} + \frac{\partial Q}{\partial T}\frac{\partial T}{\partial p^f}} + s t_i \right) \tag{39}$$

where $\widetilde{p_2^w}$ is the same as in equation (30). The expected farmer's price change from the regulated market to the liberalized one is then

$$E\left(\Delta p^f\right) = E\left(p_{Li}^f\right) - p_R^w \tag{40}$$

which also equals to

$$E\left(\Delta p^f\right) = (\theta - 1)p_1^w + Q^d \frac{\frac{\partial Q}{\partial T}\frac{\partial T}{\partial p^f}}{\frac{\partial Q}{\partial p^f}\left(\frac{\partial Q}{\partial p^f} + \frac{\partial Q}{\partial T}\frac{\partial T}{\partial p^f}\right)} + \alpha E(\Delta y_t) + s[\frac{2}{3}T - t_i] \tag{41}$$

[40] The impact of commodity market liberalization in this general case is described by the sign of the expected price change between the two regimes, $E\left(\Delta p^f\right)$. Equation (41) displays the three effects that can impact the farmer's price following the market liberalization: (i) the spatial competition, the second term in equation (41), which has a positive impact on the farmer's price; (ii) the transaction costs effect, represented by the transportation cost effect $s[\frac{2}{3}T - t_i]$, those signs depend on the location, or generally, on the characteristics of the farmer. If we assume a positive growth rate of the world income, the sign of $E\left(\Delta p^f\right)$ finally depends only on the sign and magnitude of $\phi = s[\frac{2}{3}T - t_i]$. For farmers close to the buyer, ϕ is likely to be pos-

[40] An interresting question is to evaluate the impact of liberalization on the average farmer. We consider in this paper that the average farmer is the one paying the average transport cost. In this case, the average farmer will be located at 2/3 of the radius of the market. The price difference of this farmer will be such that the fourth term of equation (41) is zero. Liberalization is likely to havea positive effect on the average farmer.

itive, which means the impact of market liberalization may increase the farmer's price; and (*iii*) the international environment, represented by $(\theta-1)p_1^w+\alpha E(\Delta y_t)$, this impact can be positive or negative, depending on the magnitude of each term. If the world income growth is high enough to offset the negative impact of $(\theta-1)p_1^w$, then the impact of the international environment on the farmer's price following market liberalization is positive. Otherwise, if the world income growth is small or negative, the international environment will negatively impact the farmer's price.

2.7 Conclusion

The paper develops a theoretical model of commodity market liberalization to analyze the farmer's price behavior. This model extends the present literature by combining three features that are generally analyzed separately: spatial competition, transaction costs, and international price variability. These three features show that market liberalization does not ensure a farmer's price increase, and thus welfare improvement. From this model, the farmer's price may increase in at least three cases: if spatial competition is at work, if the timing of the liberalization is good or if transaction costs do not increase.

First, spatial competition at work means that the mark-up price decreases. Spatial competition is the only feature which unambigu-

ously improves the farmer's price. Even if the market is liberalized, the main entry barrier, access to credit or capital, may restrict the number of private firms in the sector, and then reduce competition.

Second, good timing of liberalization is equivalent to increasing the world price during the liberalization. When the international commodity's price has a positive trend, market liberalization is likely to benefit farmers. However, governments have less incentive to liberalize the market since the SOE would be more likely to make a profit. When the international price trend is negative, the government can run a budget deficit since it may have to subsidize the farmer's price if the world price is lower than the farmer's price. The government may liberalize the commodity market, leading to all of the mixed results discussed above.

Finally, lower transaction costs will reduce the mark-up price and then improve the farmer's price. In this chapter, transaction costs have been reduced to transportation costs, but in practice they include search costs, negotiation costs, information costs, storage costs, and technical assistance. Since most of the farmers have almost no education, information costs, for instance, are very expensive for them. When the market is liberalized, farmers will bear these costs. Hence, instead of observing a reduction in transaction costs due to competition, these costs may actually increase because of the market's structure. This structure includes uneducated and

poor farmers, a poor transportation and communication infrastructure and rich buyers. The market power is then in the hands of the buyers who can easily set the prices. Finally, farmers may have to support higher transaction costs leading to welfare reduction.

Some important policy guidance may be derived from this model. Commodity market liberalization may yield rapid results in terms of government budget deficit relief, but from the farmer's viewpoint, the story is different. An appropriate legal and institutional framework to reshape the market structure can be developed to offer farmers a wide array of tools combining information access, transportation facilities and market access. These tools might help absorb farmers' vulnerability when the market is liberalized. If commodity market liberalization comes with no government actions to ease its drawbacks, most of the poorest farmers, located in remote areas, will be the first to be hurt. Consequently, along with reshaping the market structure, commodity market policies should keep a minimum role for the government and should also aim to increase productivity of farmers in remote areas or help them diversify their crops or activities.

In practice, when we analyze the farmer's price from a household survey, the net prices received by farmers, even in the regulated market regime, are different for each farmer. This seems to contradict with the theoretical model suggested above. The next chapter

will develop an empirical model closer to what is observed. The model will be then tested for the features described above utilizing the household survey data from Vietnam.

The theoretical model in this chapter represents an abstraction of the commodity market before and after liberalization in Vietnam that I discuss in the next chapter. However, this model captures some features and gives some general guidance about market liberalization. A weakness of the theoretical model is that the middleman is missing in the framework. In practice, the middleman plays an intermediary role between the farmer and the exporter/buyer. The middleman buys the farmer's production and resells it to the exporter in both regimes. The middleman is then the one receiving a uniform unit price under the regulated market while the farmer receives a differentiated unit price. Under the liberalized market, even the middleman receives a differentiated unit price. The empirical model in the next chapter improves the theoretical model by integrating the middleman in the market structure. As a result, the farmer will receive a differentiated price in both regimes.

3 The Effect of Rice Market Liberalization on the Farmer's Price: Evidence from Vietnam

3.1 Introduction

Several developing countries liberalized their domestic commodity market because of the drop of the international price during the 1980s and 1990s. The objectives of these liberalizations were twofold. The first one was to reduce or avoid a government fiscal deficit by paying "subsidies" directly to farmers. The fiscal problem was the trigger of commodity marketing reforms, including liberalization, and was primarily supported by donor countries and international development agencies. When the commodity market was regulated by the government, the farmer's price did not closely track the international price and when the world price dropped, the government was left offering the higher domestic price, instead of the lower world price. These "subsidies" caused fiscal deficits, which were unsustainable by governments.

The second objective was to ensure that the farmer would receive a higher proportion of the world price, and also to align incentives to the world price (Gilbert and Varangis, 2003). This objective should be reached through a reduction of (explicit or implicit) export taxes and an increase in efficiency of the production and marketing channel.

The goals of the liberalization were to solve the government's fiscal deficit and to improve the farmer's welfare. The first goal was easily achieved once the government limited its role in the commodity market and stopped paying "subsidies" to farmers. However, the achievement of the second goal - improving the farmer's welfare- is still questionable. The commodity market literature contained a ubiquitous discussion of the impact of liberalization on the farmer's welfare. In particular, several authors[41] analyzed the impact of various market reforms, including liberalization, on the farmer's welfare, generally at an aggregate farmer level (representative farmer vs other household groups). Paradoxically, little research has been devoted to the welfare impact of liberalization at the individual farmer level, due mainly to the lack of adequate data and a theoretical framework.

This chapter presents one step in that direction as it aims to understand how the farmer's welfare changes when liberalization occurs. By solving the two main constraints that used to limit the estimation of the liberalization impact on the farmer's welfare (at farmer's level), I hope to shed some light on the nature of the effect of liberalization and draw some policy implications for poverty alleviation in poor countries. The first constraint is the data constraint. Estimating the impact of commodity market liberaliza-

[41] see footnote 7.

tion on the farmer's welfare, requires at least two point-periods of farmer/household survey data. In addition, commodity market liberalization should have occurred between these two periods. Hence, we will be able to estimate the farmer's welfare change over two periods where commodity market liberalization occurs. The second constraint is the lack of a theoretical framework that will take into consideration the three main features that are likely to play an important role in the process: the spatial price competition, transaction costs and the international environment.

This chapter solves these two constraints and estimates the impact of rice market liberalization in Vietnam on the farmer's welfare. The first constraint - lack of data - is not an issue for Vietnam since it implemented two household surveys[42] in 1992/93 and 1997/98, with 1,017 farmers being interviewed in both years.[43] In addition, the country reformed and liberalized its rice sector in 1993, just after the first survey.

The second constraint is also partially solved by the model developed in chapter 2.[44] This model, which analyzes the impact of

[42] see appendix 2 for a description of the survey data.

[43] Out of 4,800 households interviewed in 1992/93 and 6,000 in 1997/98, about 4,300 households were interviewed in both years. Among these 4,300 households, 1,017 were farmers with rice marketing surplus.

[44] Notice that the standard of living or welfare of many farmers in developing countries, especially in Vietnam, depends on the sale of commodity crops (coffee, rice,...) for export. The price the farmers receive for their outputs has major implications for their welfares. If the farmer receives a high price for his production, his income will increase and thus the welfare. Therefore, the analysis of the farmer's price done in chapter 2 is completely relevant for the welfare analysis of the farmer.

spatial price competition, transaction costs and the world price on the farmer's price, is a good framework for the empirical analysis. Unfortunately, the model has at least two major limitations. It assumes that, in the regulated market regime, all farmers receive the same price for their production from the SOE, and there are no middlemen. However, the analysis of the market structure and the farmer's price survey data show that this is not the case. Farmers receive different prices for their production, mainly due to the intervention of middlemen in the marketing system. Indeed, under the regulated market, the SOEs offer a unique price, but to the middlemen.[45] Once they receive the unique price from the SOE, they will offer a differentiated price to the farmer based on transaction costs (transport cost, search cost, negotiation skill, and level of infrastructure around the farmer's location). This theoretical model will then be modified such that it will consider the effective price received by the farmers, which is captured in any household/farmer survey, and not the unique price offered to the middlemen. Once these constraints are solved, the analysis of the market's liberalization impact on the farmer's welfare answers the question of whether (and how) the three features (spatial competition, transaction costs and the international environment) identified in the conceptual framework

[45] Middlemen play a crucial role in the commodity marketing system since they are the link between producer/farmer and the export firm or the retail seller. In Vietnam, more than 90 percent of the rice marketing surplus was collected by middlemen according to the 1992/93 and 1997/98 survey.

impact the farmer's price.

This chapter is related to Pinske et al (2002), who investigate the nature of price competition among firms in a differentiated product market and Kapoor (2003), who analyzes price competition in the US gasoline market. In this paper, I add three main innovations to the literature. First, this chapter analyzes the impact of commodity market liberalization at the farmer's level. Second, it combines household survey data and geographic information data to allow the estimation of transaction costs and spatial competition effects after market liberalization. Finally, it is one of the few papers on commodity market liberalization that take advantage of recent developments in spatial econometrics to estimate these effects.

The remainder of the chapter is organized as follows. The next section provides a detailed description of the empirical model. The data and estimation results are presented in section three. Robustness tests of the empirical estimation are performed in section four.

3.2 Empirical Model

Empirical evidence indicates that the role of middlemen is important in the commodity marketing channel. The middlemen serve as intermediary agents whose role is to provide transaction services between farmers and the SOEs or the private exporters.[46] In the case

[46] In the Phillipines for instance, Hayami et al (1999) find that around 75 percent of the rice marketing surplus was collected by the middlemen (collectors) before it reached the rice

of Vietnam, Table 1 gives the percentage of farmers, among those who produce and sell their rice production to individual buyers or cooperative during the two surveys. Among these farmers, less than one percent said that they sold their production to a government office or to a cooperative, while more than 99 percent acknowledge that their production was bought by an individual. Hence, at the farmer's level, either market regime does not matter for the way the production is sold. In each market regime, the farmer faces the middleman.[47] In addition, previous studies used to take the price that the middleman obtains from the export firm to analyze the impact of market liberalization on the farmer's welfare. This may be misleading since there is an important gap between the middleman and the farmer's price. It is then necessary to develop a model that corrects these weaknesses.[48]

This section indeed develops an empirical model that corrects the weaknesses of the theoretical model. This model includes the effective price received by the farmer and is then used to test the impact of market liberalization in Vietnam. Doing so does not mean

mills. In Uganda, about 85 percent of the coffee production was purchased by middlemen (Fafchamps and Hill, 2005).

[47] The main difference comes from the middleman. After they receive a unique and fixed price from the SOE under the regulated market regime, middlemen will offer a differentiated price to farmers because of transaction costs and profit seeking.

[48] Notice that the empirical model in this chapter holds even if the government is the only exporter under the liberalized regime under two conditions: (i) the domestic purchase of the commodity is liberalized, such as private firms or middlemen can freely purchase the production and resell it to the government for export; and (ii) the government does not fix the commodity price for the whole marketing season, but price varies with the international price over the marketing season. This is a lower level of market liberalization, but this will not change the main results of the model.

that we analyze if we have price competition after liberalization at the farmer's level. This model goes beyond the existence of the price competition. Because of the presence of middlemen in both markets, there is competition before and after liberalization, as the model will show. The market structure and characteristics (low level of infrastructure, low education of farmers in addition) make it difficult for farmers to reach the market to sell their production. They rely to the middlemen for the transaction between them and the exporter. Then, middlemen are in the market in each regime. I will show that competition can decrease after liberalization with an increased market power for the middleman. The impact of transaction costs on the farmer's price is also assessed with this new model. However, the effect of the international price is difficult to measure since it is a constant for each farmer. The following section describes the empirical model.

3.2.1 Conceptual Framework

Assume there are N farmers , where $N \geq 1$. Each farmer $i\,(= 1, ..., N)$, has unique characteristics,[49] y_i, enabling him to produce a "differentiated" commodity good q_{it} at time[50] t and sold at a nominal price p_{it}. Indeed, all farmers are producing the same good, which is assumed

[49] Later on, I will define these characteristics as household characteristics (education, age,...) and geographic locations (distance to nearest road,...), making the product unique. These characteristics are equivalent to the transaction costs I discussed in the theoretical model in the sense that they make every farmer receive a unique price .

[50] t will be either the 1992/93 or the 1997/98 period of the surveys.

to be a differentiated one since each farmer receives a different price from the buyer due mainly to transaction costs and unique farmer characteristics. For notational simplicity, the subscript t, will be omitted in the remainder of this section.

There are K buyers of the commodity, indexed by $k = 1, ..., K$, that behave as follows. First, they compete for space or market share through price. Once market size is set for each buyer, he has a monopsony power on it. Each buyer k can purchase the commodity good from all farmers in his market. Buyers later resell their purchase to the world market at an exogenous world price $\overline{P^w}$. Each buyer is located at the center of his market.[51] In each market k, we have J_k farmers and $\sum_{k=1}^{K} J_k = N$. In the market of the first buyer, $(k = 1)$, we have J_1 farmers. Since each farmer receives a different price, the price vector, of dimension J_1x1, received by farmers in market 1, is $P_1 = (p_{11}, p_{12}, ..., p_{1J_1})'$. In the second market, $(k = 2)$, we have J_2 farmers and the price vector, of dimension $(J_2, 1)$, received by farmers in market 2 is $P_2 = \left(p_{2(J_1+1)}, p_{2(J_1+2)}, ..., p_{2(J_1+J_2)}\right)'$. Similarly, in market $k\,(= 1, 2, ...K)$, we have J_k farmers and the price vector, of dimension J_kx1, received by farmers in market k, is $P_k = \left(p_{k(J_1+J_2+...+J_{k-1}+1)}, p_{k(J_1+J_2+...+J_{k-1}+2)}, ..., p_{k(J_1+J_2+...+J_{k-1}+J_k)}\right)'$

[51] Notice that the optimal number of buyers and the optimal location of the buyer are not primordial for the main results of this chapter. Also, for simplification, the transport cost from the buyer to the port is assumed to be zero. I already showed at the end of the section 2.3 that a non zero transport cost does not change the main results of the model.

$$= \left(p_{k\left(\sum_{j=1}^{k-1} J_j + l\right)} \right)'_{l=1,\ldots,J_k}.$$

Finally, the price vector received by all the farmers in the country can be written $P = (P_1', P_2', ..., P_K')'$ of dimension $\sum_{j=1}^{K} J_j \text{x} 1 = N \text{x} 1$.

Before clarifying the empirical model, I will give a numerical example to make the notation easier to handle. Assume that $K = 2$ buyers, $k = 1, 2$, and there are $N = 5$ farmers such that we have $J_1 = 2$ farmers in market 1 and $J_2 = 3$ farmers in market 2, then $N = J_1 + J_2 = 5$. According to the above notation, the vector of prices in market 1 is $P_1 = (p_{11}, p_{12})\prime$ and the vector of prices in market 2 is $P_2 = (p_{23}, p_{24}, p_{25})\prime$. These price vectors can also be written $P_1 = (p_{11}, p_{1J_1})\prime$ and $P_2 = (p_{2(2+1)}, p_{2(2+2)}, p_{2(2+3)})\prime = (p_{2(J_1+1)}, p_{2(J_1+2)}, p_{2(J_1+J_2)})\prime$. The vector of prices for all farmers is then $P = (P_1' P_2')\prime = (p_{11}, p_{12}, p_{23}, p_{24}, p_{25})' = (p_{11}, p_{1J_1}, p_{2(J_1+1)}, p_{2(J_1+2)}, p_{2(J_1+J_2)})\prime$. These special notations of the farmers' prices make it easier to develop the derivation of the model in the following paragraphs.

Define the profit of buyer k by $\pi_k(P, P_k^w, y_{k*})$ where $P_k^w = \overline{p^w} I_{(K,1)}$, $I_{(K,1)}$ is a Kx1 vector of ones and $y_{k*} = (y_{k1}, ..., y_{kJ_k})'$ where y_{ki} , $i = 1, ..., J_k$, is farmer i's individual characteristics in market k. The profit function of buyer k depends not only on the prices he offers to farmers in his market, P_k, but also on the prices offered by the other buyers in the other markets due to spatial competition. This profit function means that buyers do not hold inventories. This assumption is realistic in the commodity market

because of the rapid deterioration of the commodity good and its huge storage cost. The aggregate profit of all buyers is then[52] $\Pi(P, P^w, y) = \sum_{k=1}^{K} \pi_k(P, P_k^w, y_{k*.})$ where $P^w = \overline{p^w} I_{(N,1)}$, $I_{(N,1)}$ is a Nx1 vector of ones and $y = (y'_{1*}, y'_{2*}, ..., y'_{K*})' = (y_1, y_2, ..., y_N)'$ is the vector of characteristics of all farmers.

For the empirics, a flexible functional form is taken and I use a normalized quadratic form.[53]

$$\begin{aligned}
\Pi \quad = \quad & \sum_{k=1}^{K}\sum_{l=1}^{J_k} \alpha_{kl}^{(1)} p_{k\left(\sum_{j=1}^{k-1} J_j + l\right)} + \sum_{i=1}^{N} \alpha_i^{(2)} \overline{p^w} + \sum_{i=1}^{N} \alpha_i^{(3)} y_i \qquad (42) \\
& + \sum_{k,m=1}^{K} \sum_{l=1}^{J_k} \sum_{n=1}^{J_m} \beta_{klmn}^{(1)} p_{k\left(\sum_{j=1}^{k-1} J_j + l\right)} p_{m\left(\sum_{j=1}^{m-1} J_j + n\right)} \\
& + \frac{1}{2}[\sum_{i,j=1}^{N} \beta_{ij}^{(2)} \left(\overline{p^w}\right)^2 + \sum_{i,j=1}^{N} \beta_{ij}^{(3)} y_i y_j + \sum_{i,j=1}^{N} \beta_{ij}^{(6)} \overline{p^w} y_i \\
& + \sum_{k=1}^{K}\sum_{l=1}^{J_k}\sum_{i=1}^{N} \beta_{kli}^{(4)} p_{k\left(\sum_{j=1}^{k-1} J_j + l\right)} \overline{p^w} + \sum_{k=1}^{K}\sum_{l=1}^{J_k}\sum_{i=1}^{N} \beta_{kli}^{(5)} p_{k\left(\sum_{j=1}^{k-1} J_j + l\right)} y_i]
\end{aligned}$$

Following similar works in this literature, I normalize prices by an index of commodity goods prices V such as $\widetilde{p}_{k\left(\sum_{j=1}^{k-1} J_j + l\right)} = V^{-1} p_{k\left(\sum_{j=1}^{k-1} J_j + l\right)}$, $\widetilde{p}^w = V^{-1}\overline{p^w}$ and $\widetilde{\Pi} = V^{-1}\Pi$. In addition, since the international price is exogenous to buyers, it can be treated as a constant. Eq. (42) then becomes

[52] Koopmans (1957) and Mas Collel et al (1995) have shown that the profit obtained if the buyers jointly maximize profit is the same as when each buyer maximizes his profit separately, taking price as given.

[53] Brendt, Fuss, Waverman (1997), Mcfadden (1978), Pinske et al (2002), Kapoor (2003).

$$\begin{aligned}\widetilde{\Pi} &= \sum_{k=1}^{K}\sum_{l=1}^{J_k}\alpha_{kl}^{(1)}\widetilde{p}_{k\left(\sum_{j=1}^{k-1}J_j+l\right)}+\sum_{i=1}^{N}\alpha_i^{(2)}\widetilde{p}^w+\sum_{i=1}^{N}\alpha_i^{(3)}V^{-1}y_i \\ &+\sum_{k,m=1}^{K}\sum_{l=1}^{J_k}\sum_{n=1}^{J_m}V\beta_{klmn}^{(1)}\widetilde{p}_{k\left(\sum_{j=1}^{k-1}J_j+l\right)}\widetilde{p}_{m\left(\sum_{j=1}^{m-1}J_j+n\right)} \\ &+\frac{1}{2}[\sum_{i,j=1}^{N}V\beta_{ij}^{(2)}\left(\widetilde{p}^w\right)^2+\sum_{i,j=1}^{N}\beta_{ij}^{(3)}V^{-1}y_iy_j+\sum_{i,j=1}^{N}\beta_{ij}^{(6)}\widetilde{p}^wy_i \\ &+\sum_{k=1}^{K}\sum_{l=1}^{J_k}\sum_{i=1}^{N}V\beta_{kli}^{(4)}\widetilde{p}^w\widetilde{p}_{k\left(\sum_{j=1}^{k-1}J_j+l\right)}+\sum_{k=1}^{K}\sum_{l=1}^{J_k}\sum_{i=1}^{N}\beta_{kli}^{(5)}\widetilde{p}_{k\left(\sum_{j=1}^{k-1}J_j+l\right)}y_i]\end{aligned} \tag{43}$$

, which is also equivalent to

$$\begin{aligned}\widetilde{\Pi} &= a^{(1)}+\sum_{k=1}^{K}\sum_{l=1}^{J_k}a_{kl}^{(2)}\widetilde{p}_{k\left(\sum_{j=1}^{k-1}J_j+l\right)}+\sum_{i=1}^{N}a_i^{(3)}y_i \\ &+\frac{1}{2}\sum_{k,m=1}^{K}\sum_{l=1}^{J_k}\sum_{n=1}^{J_m}b_{klmn}^{(1)}\widetilde{p}_{k\left(\sum_{j=1}^{k-1}J_j+l\right)}\widetilde{p}_{m\left(\sum_{j=1}^{m-1}J_j+n\right)} \\ &+\frac{1}{2}\sum_{i,j=1}^{N}b_{ij}^{(2)}y_iy_j+\frac{1}{2}\sum_{k=1}^{K}\sum_{l=1}^{J_k}\sum_{i=1}^{N}b_{kli}^{(3)}\widetilde{p}_{k\left(\sum_{j=1}^{k-1}J_j+l\right)}y_i\end{aligned} \tag{44}$$

where

$a^{(1)}=\sum_{i=1}^{N}\alpha_i^{(2)}\widetilde{p}^w+\frac{V}{2}\sum_{i,j=1}^{N}\beta_{ij}^{(2)}\left(\widetilde{p}^w\right)^2$,

$a_{kl}^{(2)}=\alpha_{kl}^{(1)}+\sum_{i=1}^{N}\frac{V}{2}\beta_{kli}^{(4)}\widetilde{p}^w$,

$a_i^{(3)}=V^{-1}\alpha_i^{(3)}+\sum_{j=1}^{N}\beta_{ij}^{(6)}\widetilde{p}^w$,

$b_{klmn}^{(1)}=V\beta_{klmn}^{(1)}$,

$b_{ij}^{(2)}=V^{-1}\beta_{ij}^{(3)}$,

$b_{kli}^{(3)}=\beta_{kli}^{(5)}$.

Moreover, $b^{(1)}_{klmn} = b^{(1)}_{mnkl}$, $b^{(2)}_{ij} = b^{(2)}_{ji}$, and $b^{(3)}_{kli} = b^{(3)}_{ikl}$.

Now, using the Hotelling lemma, I can derive the optimal quantity of the commodity that the buyer k will want farmer i in market k to produce

$$q_i = \frac{\partial \widetilde{\Pi}}{\partial \widetilde{p}_{ki}} = a^{(2)}_{kl_i} + \sum_{m=1}^{K}\sum_{n=1}^{J_m} b^{(1)}_{kl_imn}\widetilde{p}_{m\left(\sum_{j=1}^{m-1} J_j + n\right)} + \frac{1}{2}\sum_{j=1}^{N} b^{(3)}_{kl_ij} y_j \tag{45}$$

where l_i is such that $1 \leq l_i \leq J_k$ and $\sum_{j=1}^{k-1} J_j + l_i = i$. Next, the buyer has to make the farmer produce this quantity by offering a price for the commodity that maximizes the farmer's profit. Assume that the farmer faces various unit cost function C_i and a fixed cost F_i, then his profit function is:

$$\varphi_i = (\widetilde{p}_{ki} - C_i)q_i - F_i \tag{46}$$

The optimal price, $\widetilde{p}^*_{ki}$, at which the farmer will sell his production q_i is such that

$$\frac{\partial \varphi_i}{\partial \widetilde{p}_{ki}} = q_i + (\widetilde{p}_{ki} - C_i)\frac{\partial q_i}{\partial \widetilde{p}_{ki}} = q_i + (\widetilde{p}_{ki} - C_i)b^{(1)}_{kl_ikn_i} = 0 \tag{47}$$

where n_i is such that $\sum_{j=1}^{k-1} J_j + n_i = i$. I plug eq. (45) into (47) and solve for price

$$a^{(2)}_{kl_i} + \sum_{m=1}^{K}\sum_{n=1}^{J_m} b^{(1)}_{kl_imn}\widetilde{p}_{m\left(\sum_{j=1}^{m-1} J_j + n\right)} + \frac{1}{2}\sum_{j=1}^{N} b^{(3)}_{kl_ij} y_j + (\widetilde{p}_{ki} - C_i)b^{(1)}_{kl_ikn_i} = 0$$

$$a_{kl_i}^{(2)}+2b_{kl_ikn_i}^{(1)}\widetilde{p}_{ki}+\sum_{m=1}^{K}\sum_{n=1,n\neq n_i}^{J_m}b_{kl_imn}^{(1)}\widetilde{p}_{m(\sum_{j=1}^{m-1}J_j+n)}+\frac{1}{2}\sum_{j=1}^{N}b_{kl_ij}^{(3)}y_j-C_ib_{kl_ikn_i}^{(1)}=0$$

The farmer's price is then

$$\begin{aligned}\widetilde{p}_{ki}^{*} &= -\frac{1}{2b_{kl_ikn_i}^{(1)}}\left[a_{kl_i}^{(2)}+\sum_{m=1}^{K}\sum_{n=1,n\neq n_i}^{J_m}b_{kl_imn}^{(1)}\widetilde{p}_{m(\sum_{j=1}^{m-1}J_j+n)}\right] \\ &\quad -\frac{1}{2b_{kl_ikn_i}^{(1)}}\left[\frac{1}{2}\sum_{j=1}^{N}b_{kl_ij}^{(3)}y_j-b_{kl_ikn_i}^{(1)}C_i\right]\end{aligned} \tag{48}$$

The optimal farmer's price, $\widetilde{p}_{ki}^{*}$, depends on the price received by the other farmers in market k as well as in the other markets, the characteristics of the farmers and the production cost. Equation (48) will be the basis of my empirical estimation. This equation allows us to estimate to what extent farmer i's price is related to other farmers' price (spatial competition) and the impact of transaction costs before and after the reforms. In theory, since the same farmers have been interviewed in both surveys, any structural change of the coefficient is related to the reform that has occurred.

However, all the parameters of equation (44) can not be estimated using cross sectional data or short panel data. Therefore, it is necessary to make some assumptions on the parameters. Based on the theoretical commodity market model, the constant term can include the world income growth rate and the international price of the commodity. To take into consideration these components, a random effect model is used where $-a_{kl_i}^{(2)}/2b_{kl_ikn_i}^{(1)}=a+\mu_i$, where a is

a constant term and μ_i is independently and identically distributed (iid) with zero mean and a finite variance.

The coefficients,$-b^{(1)}_{kl_imn}/2b^{(1)}_{kl_ikn_i}$, on the right hand side of (48) represent the slope of the reaction curve of price P_{ki} with respect to the other prices. These coefficients measure the change of price $\widetilde{p}^*_{ki}$ when the other prices change by one unit. When two farmers are not in the same market, it seems natural to assume that the reaction coefficient will depend on the proximity of the markets according to their geographic location. Following Case (1991, 1992), and Pinske et al (2002), I assume that this ratio depends on a measure of the distance d_{ij} between these two farmers yielding

$$-b^{(1)}_{kl_imn}/2b^{(1)}_{kl_ikn_i} = \lambda d_{kl_imn} \tag{49}$$

where λ is a parameter to be estimated and d_{kl_imn} is a measure of distance between farmers i in market k and farmer n in market m, which is positive if the two farmers are different, and zero if not. Eq. (49) still holds if the two farmers are in the same market or not. By definition of the weighting matrix, d_{kl_imn} is positive. The meaning of the weighting matrix for farmers is discussed later on in this chapter. The sign of λ is important for spatial competition among buyers. If λ is positive, it will measures the spatial price competition among buyers. The higher the coefficient λ is, the stronger

spatial competition will be. Market liberalization is supposed to increase price competition. Meanwhile, if λ is negative, then a high commodity price at the closest farm penalized the farmer.

Commodity market liberalization can also make farmers more vulnerable, with less role of the government in the market. Thus, they will loose some marketing power and, middlemen can benefit from it. In this case, price competition will be lower under the market liberalization. In developing countries, farmers are not educated and the level of infrastructure is low. It is then likely that farmers' marketing power decreases and spatial competition will be lower under the liberalized market regime.

The coefficient $b^{(3)}_{kl_ij}/2b^{(1)}_{kl_ikn_i}$ is the slope of the reaction curve of $\widetilde{P}_{ki}$ to the characteristics of the other farmers. Then, let's define

$$\begin{aligned} b^{(3)}_{kl_ij}/2b^{(1)}_{kl_ikn_i} &= \eta d^{(1)}_{kl_ij} \text{ if } i \neq j \\ &= \delta \text{ if } i = j \end{aligned} \tag{50}$$

where η and δ are parameters to be estimated and $d^{(1)}_{kl_ij}$ is the distance between farmer i in market k and farmer j , located in any market.

In the model, variables y_j, $j = 1, ...N$, represent the commodity good's uniqueness, which is defined by the farmer's characteristics and geographic attributes of the farm. Thus, y_j reflects the factor that affects the farmer's price and can be treated as the character-

istics (or proxies) of the transaction costs. Moreover, I assume that $d^{(1)}_{kl_imn} = d_{kl_imn}$. Notice that the matrix $D_n = (d_{kl_imn})_{1\leq l_i,n\leq N,\ 1\leq k,m\leq K} = (d_{ij})_{1\leq i,j\leq N}$ is a NxN matrix.

Finally, equation (48) becomes

$$\widetilde{p}^{*}_{ki} = a + \delta y_i + \eta \sum_{\substack{j=1 \\ j\neq i}}^{N} d_{ij}y_j + \theta C_i + \lambda \sum_{m=1}^{K} \sum_{\substack{n=1 \\ n\neq n_i}}^{J_m} d_{i\left(\sum_{j=1}^{m-1} J_j+n\right)} \widetilde{p}_{m\left(\sum_{j=1}^{m-1} J_j+n\right)} + \mu_i \tag{51}$$

I stack the model in the following form

$$P_N = X_N\beta + \lambda D_N P_N + \mu_N \tag{52}$$

where $P_N = \left(\widetilde{p}^{*}_{k\left(\sum_{j=1}^{k-1} J_j+l\right)\ l=1,\ldots,J_k}\right)'_{k=1,\ldots,K}$ is a Nx1 vector of prices the farmers receive, $X_N = [1, y_N, D_N y_N, C_N]_{N\text{x}4}$ is a matrix of exogenous variables, $y_N = (y_1, y_2, ..., y_N)'$, D_N is a NxN weighting matrix whose $(i,j)\_th$ element is d_{ij}, $\beta = (a, \delta, \eta, \theta)'$. Eq. (52), the equation to be estimated, gives the farmer's price as a function of the farmer and farm characteristics and the prices received by the other farmers. Estimation procedures take advantage of recent developments in spatial econometrics and are detailed in the next section.

3.2.2 Estimation procedure

Equation (52) is a first order autoregressive spatial model. Basically, spatial autocorrelation means that a variable in one market is af-

fected by the value of that variable in neighboring markets. Two types of spatial dependence or spatial autocorrelation are known in the literature: The spatial lag dependence and the spatial error dependence.

The spatial lag dependence occurs when the dependent variable in one market is affected by the dependent variable in nearby markets. This dependence violates the OLS assumption that explanatory variables are uncorrelated with the disturbance term. exogenous variables are independent. In this case, OLS coefficients are biased and inconsistent. Additionally, the model can be written as:

$$\widetilde{p}_i = X_i\beta + \sigma \sum_{j=1, i\neq j}^{N} d_{ij}\widetilde{p}_j + \mu_i, \qquad i = 1, ..., N \tag{53}$$

where $\widetilde{p}_i$ and $\widetilde{p}_j$ are the farmer's i and j price, σ the spatial autoregressive coefficient, d_{ij} is the (i, j)-element of the spatial weighting matrix reflecting the "proximity" of farmers i and j, X_i the matrix of exogenous explanatory variables, β a vector of coefficients and μ_i the spatially autocorrelated disturbance error term. Equation (53) can be written as (52).

The second type of spatial dependence, the spatial error dependence, occurs when the error term of the price's equation in one market is correlated to the error in the neighbor's market. In this case, unobserved variables are correlated over space. This may be

the case if, for instance, we have the same buyer in two neighboring markets or buyers in different markets who mimic each other. Then, the way the buyer will set up his price or the behavior of the buyer is likely to be correlated in these markets. Furthermore, not considering spatial error dependence and running an ordinary least square (OLS) regression will provide inefficient coefficients since the assumption that the error terms are uncorrelated to each other is violated. In this case, the covariance matrix is not diagonal and non-diagonal elements express the structure of the spatial dependence (Anselin, 1999). The error variance matrix has the following form $E(\mu_N \mu_N') = \Omega(\vartheta)$, where ϑ is vector of parameters, and with the coefficients in a spatial autoregressive (SAR) or spatial moving average (SMA). If the errors have a SAR error form, the SAR error model is

$$P_N = X_N\beta + \mu_N \text{ where } \mu_N = \lambda D_N \mu_N + \varepsilon_N$$

since $\mu_N = (I - \lambda D_N)^{-1}\varepsilon_N$ then $P_N = X_N\beta + (I - \lambda D_N)^{-1}\varepsilon_N$ which is equivalent to

$$P_N = \lambda D_N P_N + X_N\beta - \lambda D_N X_N\beta + \varepsilon_N \tag{54}$$

which is a spatial lag dependence model as in (53) with an additional term $D_N X_N$.

For each type of spatial correlation, a special regression model

needs to be applied: model (53) or model (54). Before the spatial regression is performed, one needs to implement a Moran's I test[54] on the OLS residual to check for the presence of spatial correlation. If spatial correlation is detected, we need to find its type. The choice between the two spatial autocorrelations, is determined the significance[55] of σ and λ. If both tests are significant, the one with the higher Lagrange multiplier is selected.

A more general approach can also be adopted using a model with both specifications. Assume that, in equation (52), we have spatial correlation in the disturbance term

$$\mu_N = \rho D_N \mu_N + \varepsilon_N \tag{55}$$

where ρ is the spatially autoregressive parameter and ε_N is an Nx1 vector of innovations. The Generalized Spatial Two-Stage Least Squares (GS2SLS) procedure, developed by Kelejian and Prucha (1998), allows us to estimate this general equation. The advantage of this estimation technique is that it can be applied to a spatial model that includes both spatial error and spatial lag correlations. Also, the assumption of normality of the error term is relaxed.

Recall the model to be estimated is (52) with (55). Kelejian and

[54] The Moran's I statistic is $I = (N/S)(e'D_N e/e'e)$ where e is the vector of OLS residual and S is the sum of all elements in the weighting matrix and N the number of observations. If the weighting matrix is standardized then $I = (e'D_N e/e'e)$

[55] done through a Lagrange multiplier test

Prucha (1998) proposed a three step-method to estimate this model.[56] They rewrite the model

$$P_N = Z_N\delta + \mu_N \tag{56}$$

$$\mu_N = \rho D_N \mu_N + \varepsilon_N \tag{57}$$

where $Z_N = (X_N, D_N P_N)$ and $\delta = (\beta', \lambda)'$. In the first step, the above model is estimated by a two-stage least squares estimator (TSLS), where the matrix of instruments, H_N, is a subset of linearly independent columns of $(X_N, D_N X_N, D_N^2 X_N)$:

$$\begin{aligned} \widetilde{\delta}_N &= \left(\widehat{Z}_N' \widehat{Z}_N\right)^{-1} \widehat{Z}_N' P_N \\ \widetilde{\mu}_N &= P_N - Z_N \widetilde{\delta}_N \end{aligned} \tag{58}$$

where $\widehat{Z}_N = T_{H_N} Z_N = (X_N, \widehat{D_N P_N})$, $\widehat{D_N P_N} = T_{H_N} D_N P_N$ and $T_{H_N} = H_N \left(H_N' H_N\right)^{-1} H_N'$. Spatial autocorrelation of the error term is tested using the residual term I obtained from the previous estimation and the Moran-I test. If it is the case, the second step, which consists of the estimation of the autoregressive parameter ρ, estimates ρ and

[56] For a detailled discussion on these three steps, see Kelejian and Prucha (1998, 1999).

σ_ε^2 as the nonlinear least squares estimators that minimize

$$\left[g_N - G_N \begin{bmatrix} \rho \\ \rho^2 \\ \sigma_\varepsilon^2 \end{bmatrix} \right]' \left[g_N - G_N \begin{bmatrix} \rho \\ \rho^2 \\ \sigma_\varepsilon^2 \end{bmatrix} \right] \tag{59}$$

where

$$\begin{aligned} G_N &= \frac{1}{n} \begin{bmatrix} 2\widehat{\mu}_N' \widehat{\overline{\mu}}_N & -\widehat{\overline{\mu}}_N' \widehat{\overline{\mu}}_N & N \\ 2\widehat{\overline{\mu}}_N' \widehat{\overline{\mu}}_N & -\widehat{\overline{\mu}}_N' \widehat{\overline{\mu}}_N & Tr(D_N' D_N) \\ \widehat{\mu}_N' \widehat{\overline{\mu}}_N + \widehat{\overline{\overline{\mu}}}_N' \widehat{\overline{\overline{\mu}}}_N & -\widehat{\overline{\mu}}_N' \widehat{\overline{\overline{\mu}}}_N & 0 \end{bmatrix} \\ g_N &= \begin{bmatrix} \widehat{\mu}_N' \widehat{\mu}_N \\ \widehat{\overline{\mu}}_N' \widehat{\overline{\mu}}_N \\ \widehat{\mu}_N' \widehat{\overline{\mu}}_N \end{bmatrix} \end{aligned}$$

and $\widehat{\overline{\mu}}_N = D_N \widehat{\mu}_N$, and $\widehat{\overline{\overline{\mu}}}_N = D_N^2 \widehat{\mu}_N$. In the last step, a Cochrane-Orcutt transformation is applied to (58) and estimated by a TSLS. The solution is finally

$$\widetilde{\delta}_N = \left(\widehat{Z}_{N*}'(\widetilde{\rho}) \widehat{Z}(\widetilde{\rho}) \right)^{-1} \widehat{Z}_{N*}'(\widetilde{\rho}) P_{N*}(\widetilde{\rho})$$

where $\widehat{Z}_{N*}'(\widetilde{\rho}) = T_{H_N} Z_{N*}'(\widetilde{\rho})$, $Z_{N*}'(\widetilde{\rho}) = Z_N - \widetilde{\rho} D_N Z_N$, $P_{N*}(\widetilde{\rho}) = P_N - \widetilde{\rho} D_N P_N$.

3.3 Data and Results

3.3.1 Agricultural reforms in Vietnam

The model is estimated using data collected in two national surveys of Vietnam in 1992/93 and 1997/98. Before I present the data, I will briefly[57] discuss the agricultural reforms in Vietnam that made the country a good candidate for my estimations. Recent agricultural reforms in Vietnam have been done through two main steps (Che et al., 2002). The first step, which covers the period 1981-1987, is characterized by the output-contracting regime.[58] Under this regime, farmers were fully responsible for farming activities on their allocated land and had to deliver a certain quota of production. Farmers were allowed to manage their excess production. This regime was a semi-success since it gave farmers more control over their production. However, the success of the output contracting regime was not sustained, and coupled with bad weather eventually caused the food crisis in 1987.

The second step, the market liberalization (1988-present) boosts agricultural production. This step began with Resolution 10 in 1988 that was the first move to give property rights to the farmers. They were given more autonomy over their production and also over the

[57] For a detailed presentation of Vietnam economics and agricultural reforms, see appendix 1, and also Che et al (2002), Ninh (2003).

[58] The government introduced the output-contracting regime with the issuing of Directive 100 CT/TW in January 1981.

ownership, the purchase, the selling and transfer of their means of production.[59] As a result, farmers had an incentive to work harder, this was a key contributor to the substantial increase in rice production in 1988 and 1989 (Ninh, 2003). However, several problems remained: the rice market was still controlled by the government, and land was fragmented into small plots.[60] To solve these problems, the government adopted Resolution 5-HNTW in 1993. This new law gave farmers the right of long-term land use, the right to exchange, transfer, lease, inherit and mortgage land. This resolution also lifted rice market barriers and encouraged more private firms to enter the sector as well as renovating SOEs. Today, farmers operate in free markets. Overall, agricultural reforms in Vietnam gave more autonomy to farmers, and the incentive to work harder. As a result, Vietnam experienced a huge increase in rice production which turned the country from a net rice importer at the end of the 1980s to the second largest rice exporter in the world during the 1990s.

3.3.2 Data

This paper benefits from two unique, extensive and rich data sets contained in the Vietnam Living Standard Surveys (VNLSS). The data sets were collected by the Vietnam's General Statistical Of-

[59] such as machines, buffaloes, oxen, and agricultural instruments

[60] particularly in the North, and this caused difficulties in mechanisation, irrigation, specialisation, and product procurement

fice in the 1992-93 and 1997-98.[61] 4,800 households were covered in the 1992-93 survey and 6,000 in 1997-98. The main advantage of these surveys is the coverage of the same 4,301 households in both years. While the number of households surveyed each year is representative of the population, the households in the panel data are not necessarily representative at the national level. Nevertheless, it is the largest household panel data available I am using.

For the estimation, I use a sub-sample of the data consisting of rice farmers that produce and sell rice, and for whom the per-unit price of rice is available.[62] This yields a sample of 1,400 farmers survey in 1992/93, 1,520 in 1997/98 and 1,017 farmers if I consider the same farmers in both years. Vietnam is a good example for my estimation because data for the same farmers are available and the country shifted to a domestic free rice market in 1993, just after the first survey. Before I discuss in detail the empirical results, the following paragraphs give a description of the sub-population of the surveys used in my estimations (1,017 rural farmers).

The household size distribution of the population remains almost the same and the education level of the farmers increases during the two surveys. Table 2 displays the main characteristics of the sam-

[61] These surveys were conducted with the financial assistance from the United Nation Development Program (UNDP) and the Swedish International Development Agency (SIDA) and the technical assistance of the World Bank.

[62] the per-unit price of rice is calculated as the total revenu from rice over the quantity of rice sold.

ple population (1,017 observations) of my analysis in 1992/93 and 1997/98. The first two columns show that the regional distribution of the population is almost the same in both surveys. Since the farmer's main activity is linked to the field, it is difficult to move to other areas. In terms of household size, the share of the household of medium size (4 to 6 members) increases from 47 percent in 1992/93 to 48.3 percent in 1997/98. The level of education of the farmers increases between the two surveys with more than 90 percent of the population with at least a primary education level in 1997/98 compared to about 70 percent in 1992/93.

The poverty level of the farmers decreases during the five-year period. The third and fourth columns of Table 2 show that poverty incidence has declined during the two surveys from 61.5 percent in 1992/93 to 37.6 percent in 1997/98, which means a 39 percent decrease of poverty over this five-year period. The analysis of poverty regarding the other characteristics of the population leads to similar results for the entire Vietnamese population.[63] The robustness of the poverty reduction can be tested using the stochastic dominance theory.[64] Figure 2 plots the cumulative density functions (CDFs) of the distribution of per capita expenditure in the two surveys. For

[63] See Glewwe et al (1999) for a detailed description of the poverty profile of Vietnam for these two surveys.

[64] Stochastic dominance theory ranks welfare measure distributions. The aim is to compare two welfare distributions, whose cumulative density functions (CDFs) are $F_1(x)$ and $F_2(x)$, and to be able to say which one is "better" than the other. The first-order stochastic dominance definition states $F_1(x)$ first-order stochastically dominates $F_2(x)$ if and only if for

simplification, the per capita expenditure has been re-scaled to one. This graph allows us to conclude that poverty in the sub sample of our interest has unambiguously decreased between the two surveys since per capita expenditure in 1997/98 is "better" or stochastically dominates the per capita expenditure in 1992/93.

Poverty reduction is also a fact across regions among my sample. Vietnam is divided in seven regions (see Figure 3). The analysis across these regions also reveals a decline of poverty in every region. The largest decline is in the Southeast region, with a reduction of 55 percent in the poverty incidence ratio. The second largest reduction comes from the Red River Delta, where poverty decreased from 74.6 percent of the population to 38.5 percent over the five years.

Household size and education level of the head of the household are strongly correlated to welfare. Table 2 also shows the distribution of poverty according to the household size and education. Small families have the lowest poverty incidence ratio in both years and experience the highest poverty reduction between the two surveys. Households with less than four members experience a poverty reduc-

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all monotone non decreasing functions $\alpha(x)$

$$\int \alpha(x)dF_1(x) \geq \int \alpha(x)dF_2(x) \Leftrightarrow F_2(x) \geq F_1(x)$$

where the integral is taken over the whole range of x. The equation above can be interpreted as the average value of α is at least as large in distribution 1 as in distribution 2, no matter how we value x. In consequence, distribution 1 is "better," in the sense that it has more of x, and it stochastically dominates distribution 2. This also means that F_2 always has more mass in the lower part of the distribution, which is why any monotone increasing function ranks distribution 1 ahead of distribution 2 (Deaton 1997).

tion from 58.9 percent in 1992/93 to 24.3 percent in 1997/98. Large households have the smallest reduction of its poverty incidence from 60.6 percent to 50 percent.

The higher the education level of the farmer, the higher the poverty reduction is between the two surveys. Farmers with no education experience modest reduction in poverty (-25 percent) while poverty decreased by 56 percent for farmers having at least a technical education. In the second survey, all farmers with a university education level moved out of poverty.

The last three columns of Table 2 display the real per capita expenditure, in US$, in 1992/93 and 1997/98.[65] Overall, real expenditure per capita rose by 66.4 percent, which corroborates the poverty incidence number discussed in the previous paragraphs. The distribution of the real per capita expenditure according to the seven regions of Vietnam confirms the highest poverty reduction (-55 percent) of the South East region. This region experienced the highest increase of per capita expenditure, climbing from US$123 to US$269

[65] Both surveys took place over a long period of time (about 11 months) and across different regions. It is then possible that prices, collected for most of the food items, vary over time and standard of livings are also different across regions. To make the prices and expenditures comparable within surveys and between surveys, there is a need to calculate a spatial and monthly deflator indexes. A monthly price deflator has been constructed based on the monthly consumer index (provided by the General Statistical Office) with January 1993 and January 1998 as the base month. This deflator is then used to remove temporal variation. For spatial difference, a spatial price deflator has also been calculated. Instead of choosing one specific region as the base region, the national average has been used as the base group. Therefore, the spatial price indexes measure the difference between the country region and the national average of all Vietnam. Using the spatial and temporal deflators make prices and expenditures comparable in each survey. I then used the annual exchange between the Vietnam Dong and the US dollar to have these values in US$.

in 1997/98. The Mekong River Delta had the lowest per capita expenditure gain (38 percent).

Once again, one can say that household size and education level are correlated to expenditure level. Small size families had the highest per capita expenditure increase (81 percent). Similarly, households in which the head had no education were the poorest (US$169), and experienced the lowest per capita expenditure growth (41 percent), compared to households where the head had a university education level (US$237 and a growth of 119 percent).

The farmer's price increases less than the world price over the five-year period. Table 3 displays the farmers real rice's price (US cent/kg) and rice area cultivated during the two surveys. Between the two surveys, the farmer's price increased on average by 17.7 percent from US cent 16.2 to US cent 19.1. Meanwhile, the world price of rice increased from US cent 22.1 to US cent 30.5 (38 percent increase). Clearly, the entire world price increase was not transmitted to farmers. Regarding the regions, Central Highland region experienced the highest farmer price increase (41 percent), while the Northern Upland and Mekong River Delta had the lowest farmer price increase (15 percent). The main regions are worth mentioning because of the difference in the average farm size. The Red River Delta had the lowest farm size with only $0.5ha$, while the Mekong River Delta had the highest farmer size ($2.2ha$). The average size of a

farm increased overall by 10 percent between the two surveys, which is modest compared to the total production growth (35 percent).

Table 4 displays the average per capita rice production, autoconsumption and marketing surplus during the two surveys. Per capita average rice production increased by 41.1 percent overall. The Southeast region almost doubled its production per household (83 percent of increase) and the Mekong River Delta is always the most productive region in terms of production per household. Over the five-year period, rice autoconsumption increased by only 6.1 percent and the Northern Upland region experienced the highest increase (51 percent), while the Mekong River Delta reported a decline of 11 percent. Marketing surplus almost doubled between the two surveys from 956 kg in 1992/93 to $1,831kg$ in 1997/98. This trend is the same across regions where the lowest growth rate of the marketing surplus is in the Northern Upland with 40 percent.

Lastly, tables 5 to 7 give some statistics of the farmer's revenue from rice, the rice quantity sold and the per-unit rice price. The per-unit farmer price of rice is obtained by dividing revenues and quantities. This is what I will call the effective price received by the farmer. For each of these tables, we have the mean (in thousand of Vietnam Dong), the coefficient of variation (%), the skewness and the Kurtosis of the variable. The first observation is that the means of the rice price almost double between the two surveys. Second, the

price of rice during the first survey exhibits much higher variability than the price of rice in the second survey, as measured by the coefficient of variation. One could have expected higher variability under the liberalized regime. The variability of the revenue and quantity are almost the same in the two surveys.

After the characteristics of the sample are summarized, the description of the variables to be used in the empirical tests are discussed in the following paragraphs. The effective price received by the farmer is mainly affected by transaction costs from the buyer's location to the farm and by the price competition among buyers. Basically, transaction costs are the full cost of carrying out exchanges (Coase, 1960). The complexities of commodity exchanges are the main sources of transaction costs. The literature classifies the transaction costs into Proportional Transaction Costs (PTC) and Fixed Transaction Costs (FTC).

PTC include the "per-unit cost of accessing markets associated with the transportation costs (transport cost, packaging or handling)" (Key, Sadoulet et al, 2000). These transaction costs can be easily estimated in a one dimension space. PTC are generally captured by transport costs or the distance from the farm to the buyer's door or by the level of infrastructure. However, these data are not available in the survey. Following the literature, I will capture the effect of PTC by using the farm characteristics and geographic lo-

cation as a proxy.

To capture the PTC, I added geographic information data to the survey data. My sample population is located in 90 small communities across Vietnam. Table 8 gives the number of communes by region in the country. However, the collection of geographic information is not possible at the farm level, but only at the community level. To address this missing data problem, I attributed the value of the data of each community to all farmers in that community. By doing so, I assumed a high degree of homogeneity among farmers in close geographical proximity. Using the longitude and latitude, available for each community, I estimated proxies of PTC with a Geographical Information System (GIS) software. This software gives several geographic characteristics of the farm.

The variable added to the survey data and used as a proxy of PTC is the population size in a radius of 10 km (POP10), in thousands. The population size living in a 10 km radius is a good proxy of PTC since it may denote a close market and the level of infrastructure. If more people are living around a farm, it is then likely that there is a nearby market. The proximity of a market to the farm should reduce PTC for the farmer, and he should then receive a higher effective price for his production. In addition, more people living in an area increase the possibility for a high level of infrastructure, and thus a reduced PTC.

Unlike PTC, FTC are invariant to the quantity of the commodity sold and include search costs, bargaining costs, negotiation costs, monitoring costs, and enforcement costs. Therefore, FTC are a multidimensional variables. Following the literature on transaction costs (Coase, 1960; Sadoulet et al, 1991, 2000; Skoufias, 1995), I will measure the impact of FTC on the farmer's price by using the farmers' personal characteristics as proxies for FTC.

Farmers' characteristics are individual and unique attributes. Characteristics such as education, age, and gender of the farmer have a direct or indirect effect on FTC. Williamson (1979) discusses how costly transaction costs can be and notes that information asymmetry may forbid poor farmers to access better technology or better prices for their production. Education (EDUCATION) is a good proxy for information costs, in the sense that the more educated the farmer is, the easier it will be for him to access and understand a larger variety of information through newspapers, radio, and the internet. Also, an educated farmer can understand information at a lower cost. Thus, a high education level should reduce the transaction costs. Information costs can also be reduced by information access. The easier it is for the farmer to access information, the lower its price will be. Thus, owning a radio or a TV (INFO) should be a good proxy for information cost. Similarly, the ability to move easily by owning a car or motorbike can help the farmer increase his

bargaining power by comparing price. In the empirical estimation, the variable is labeled MOVE .

Experience in farming and negotiation skills (personal contacts, better opportunities at a lower cost, reputation,...) can be captured by the age (in years) of the head of the household (AGE). Older and more experienced farmers have more personal contacts, which allows the discovery of trade opportunities at lower costs. Hence, older farmers are expected to experience lower FTC. The gender (SEX) of the farmer should also impact the FTC in the sense that women tend to face higher transaction costs than men. Several authors (Matunguel et al, 2000) argue that women in the farming sector face several constraints such as weak property laws, greater legal uncertainty in court, and lack of equipment. These variables (education, age and sex), discussed above, are the unique characteristics of the farmers that allow "product differentiation", as stated in the empirical model, and are used as proxies for FTC .

In addition to transaction costs, this model tests for spatial price competition. This effect is captured in the model by the impact of the "neighbor" or "closest" farmer's price. Notice this price is an endogenous variable. I instrumented the nearest neighbor's price.[66] Following Kelejian and Prucha (1999), I use exogenous ex-

[66] Instrumental variables have two main properties: (i) they are uncorrelated with the disturbance term; and (ii) they are correlated with the variable they replace. In my case, I need to instrument the neighbor price with variables that are independent with the disturbance term and correlated with the neighbor price.

planatory variables for the community (X_n) and for the nearest community (D_nX_n) as instruments for this variable. I also use the exogenous explanatory variables of community nearest to the nearest community ($D_n^2X_n$). I then estimate the model using Kelejian and Prucha (1998, 1999) as discussed previously (two-stage least squares (2SLS) procedure and then correction for spatial correlation). In the regression, the instruments H_n are used to approximate $Zn = (X_n, D_nP_n)$ and $D_nZn = (D_nX_n, D_n^2P_n)$ in term of the predicted values $\widehat{Z}n = P_{H_n}Z_n$ and $\widehat{D_nZ}n = P_{H_n}D_nZ_n$ where $P_{H_n} = H_n(H_n'H_n)^{-1}H_n$. In principle, $\widehat{Z}n$ and $\widehat{D_nZ}n$ should approximate, as closely as, possible, $E(Zn)$ and $E(D_nZn)$, the ideal instruments. Choosing the instruments $(X_n, D_nX_n, D_n^2X_n)$ insures that $\widehat{Z}n = \left(X_n, \widehat{D_nP_n}\right)$ and $\widehat{D_nZ}n = \left(D_nX_n, \widehat{D_n^2P_n}\right)$ with $\widehat{D_nP_n} = P_{H_n}D_nP_n$ and $\widehat{D_n^2P_n} = P_{H_n}D_n^2P_n$.[67] Notice also that the elements of H_n are bounded in absolutes values. [68] Furthermore, the estimators remain well defined asymptotically, which is the case with the choice of the instruments H_n above. This ensures the validity of the instruments H_n.

The last and most important data for the estimation is the weighting matrix, D_N. The weighting matrix describes the proximity between any two farmers in our data set and it is a NxN matrix such that in each row i, a positive number d_{ij} specifies j as a neighbor of i. By definition, $d_{ii} = 0$, which means that no observation is its

[67] assumption 6 in Kelejian and Prucha, 1998 is then satisfy
[68] in light of assumption 3 and 4 of Kelejian and Prucha, 1998

own neighbor.[69] Several types of weighting matrixes are used in the literature based on the geographic distance, economic distance, and geographic boundary. Neighbors, in my model, are defined at two levels. A community k is "neighbor" to a community m if m is the "closest" community to k. Then, all farmers in community k and m will be neighbors. To define the closest community to k, I can use the road distance or the Euclidean one. In my case, the road distance is not available, so using the latitude and longitude of each community, I calculated the Euclidean distance.[70]

Also, following Case (1991, 1992), I assume that all farmers in the same community are "neighbors". This assumption is reasonable since farmers in a rural area primarily have contact with farmers close to them. Finally, the weighting matrix is characterized $D_N^* = \left(d_{ij}^*\right)_{i,j}$ such that $d_{ij}^* = 1$ if i and j are "neighbors", as defined above, and $d_{ij}^* = 0$ otherwise. The rows of D_N^* are then standardized. The standardized matrix $D_N = \left(d_{ij}\right)_{i,j}$ is such that each $d_{ij} = d_{ij}^* / \sum_j d_{ij}^*$ indicating that the farmer's neighbors have the same amount of influence.[71]

[69] See Anselin (2002) for a detailed discussion on the weighting matrix.

[70] The formula to calculate the Euclidean distance, using the longitute and latitude, $= r * acos[sin(lat1) * sin(lat2) + cos(lat1) * cos(lat2) * cos(lon2 - lon1)]$ where $r = 6378.7$ kilometers and (lat1, lon1) and (lat2, lon2) are the latitude and the longitude of location 1 and 2

[71] The standardized matrix form eases the interpretation and makes parameter estimates between different models more comparable (Anselin, 2002).

3.3.3 Empirical Results

Tables 9 and 10 report the estimations for the regulated market (1992/93) and the liberalized market (1997/98), respectively. The first two columns of each table present the results from the ordinary least squares (OLS) and the two-stage least squares (2SLS). Column three displays the OLS after error auto correlation correction. The last column shows the result of the Generalized Spatial Two-Stage Least Squares (GS2SLS). The first three columns of each table are presented to show how misleading the results could be if we did not correct for spatial autocorrelation and did apply a simple OLS. For instance, looking at the coefficient of the price in the neighbor farm (D_nP_n), the OLS result underestimates the competition effect. The OLS coefficients are 0.009548 and 0.004764, respectively, in 1992/93 and 1997/98, while these coefficients are 0.01009 and 0.007727 and significant for the same years.

These results show several interesting features.[72] First, spatial price competition affects the farmer's price in both market regimes. The spatial correlation in prices among communities is statistically significant and positive in both years. This means that the effective price received by a farmer is positively correlated to those of his neighbors. This result confirms the prediction of the empirical

[72] One needs to be careful with the following results. My sample includes 1,017 farmers that are not representative of the farmer population in Vietnam. Caution should then be taken before generalizing these conclusions to the whole country or to all the farmers in Vietnam.

price competition model. Hence, spatial competition among buyers benefits farmers in both market regimes. However, the spatial competition effect is smaller after the market liberalization. Indeed, the coefficient of the nearest community price is 0.01009 under the regulated market regime (1992/93), while it decreases to 0.007727 under the liberalized regime (1997/98). As noted earlier, these coefficients measure spatial price competition.

I perform a significance test of the coefficients of the two estimations.[73] The results show that the competition coefficients are statistically different during both surveys. The market liberalization reduces the level of competition. The structure of the market may explain this result. The farmer is price taker. In addition, under the liberalized market regime, the farmer is more vulnerable. However, notice that competition effects are very small. A 1% increase of the neighbor price is translated by 0.01% increase in price in 1992/1993 and a 0.0007% in 1997/98. When we measure this effect at the mean price for the average farmer, this implies an increase of price from 1,700 VD/kg to 1,700.17 VD/kg in 1992/93 and an increase

[73] For the test, I decompose the IV-regression into 2 regressions. First, I estimate the endogenous variable using the instruments. Using its predicted value, I did a second regression for each survey. I then test the equality of the coefficients of the competition effect. I cannot accept the assumption that the difference coefficients are zero. I did the test for the spatial competition coefficient and for the PTC coefficient. The results of these tests are the following: For the spatial competition coefficients: χ^2=21.34 and Prob>χ^2=0.0000 and for the PTC coefficients: χ^2=7.66 and Prob>χ^2=0.0056. These results show that the coefficients are statistically different each year. These tests assume independence of the two samples, which is not obvious. If this assumption does not hold, the covariance will be non zero. The results of the test will be slightly different but the main results of the model, the presence of competition before and after liberalization, will still hold.

from 2,700 VD/kg to 2,701.9 VD/kg in 1997/98. Hence, even if the competition effect is statistically significant, economically, its effect on the unit price is negligible.

As Kapoor (2003) noticed, caution should be observed when we interpret the above results. There are cases where prices move together (positive correlation), but there is no price competition (i.e. if firms collude to fix a higher price). This dilemma can be solved if we let the farmer 's price be inversely related to the income of the neighboring farmer during each regime.[74] The intuition is the following: During each market regime buyers compete for farmers; therefore, it is likely that rich farmers with large production and reduced transaction costs, are more attractive to buyers. And, this implies that farmers with low income will have to accept a "lower" price in order to sell their production.

To capture these effects, I added two variables to the regression: the cultivated rice area[75] and the per capita income. The first variable will capture the production scale effect of the farmer. Large producers (large area cultivated) are expected to accept lower prices in order to sell their production faster. The second variable, the per capita income, enters the regression under two forms. First, it will

[74] Kapoor (2003) developed a spatial product differentiation model with heterogenous customers where he showed that price is inversely related to the neighboring region when customers are heterogenous. This model can be easily adapted for my commodity market liberalization model.

[75] The quantity produced would have been a better variable, but this would have created an endogeneity since the quantity produced is already used to estimate the rice price.

capture the farmer's own welfare effect on the price he received, and second, it will capture the neighboring farmer's welfare effect on the farmer's price. Two opposite effects are then at play. A rich farmer has higher bargaining power because he can find other opportunities elsewhere and has less constraints. In that scenario, income per capita should have a positive effect on the farmer's price. On the other hand, having a large production should allow the farmer to accept a lower price in order to sell all of his production faster.

As expected, the coefficient of cultivated rice area (-0.000001) is negative in 1998 and significant. The coefficient for the real per capita income is positive (0.000018 and 0.000015 respectively) both years, but significant only under the market liberalization regime (1997/98). Then, being wealthier increases the farmer's bargaining power. Regarding the neighboring welfare effect, its coefficient is negative and significant under the two market regimes. Hence, farmers are penalized by a wealthier neighbor. Again, like in the competition effect, the coefficients are very small and their impact on the price received by the farmer is also small.

Next, I examined the transaction costs effects. I started by analyzing the PTC. The population size in a 10 km radius of the farm (POP10) is the proxy used for the PTC. As expected, PTC affects the farmer's price under the market liberalization regime (1997/98). The coefficient of POP10 is positive both years, but statistically sig-

nificant only under the liberalized market regime. This corroborates the framework of chapter 2. In the regulated regime, PTC does not impact farmer's price as it is supported collectively by all farmers. A reduction of the PTC by 1%, as measured by an increase of the population in a 10 km radius, is translated by an increased id the farmer price by 0.14% in 1997/98.

After the PTC effects, I look at the effect of the FTC, represented by the farmer's personal characteristics. Among the proxies used, few are significant in the estimation. The coefficient of SEX is positive both years and significant only in 1997/98 (0.030976), showing that there is still a bias of being a woman in the rural world and selling rice. Ownership of a TV or radio (INFO), used as an information access measure, has a positive and significant impact in 1997/98. Also, being a rice buyer in 1993 has a positive and significant impact (0.026354) in 1997/98. Indeed, knowing the rice market is an important factor while selling production, and having been a buyer previously helps in this direction.

Land ownership, which is used to measure the marketing power of the farmer (in a sense that a land owner has less pressure to sell quickly his production), affects farmer's price in both market regimes (0.01712 in 1992/93 and 0.000066 in 1997/98) but they are significant. The other variables of FTC (Education, Age, religion, household size) have no impact on the farmer's price according to

my empirical estimations.

Overall, the main results of my empirical model hold. There are spatial price competition in both market regimes, as the model predicted. In addition, contrary to what proponents of market liberalization argue, price competition did not increase with rice market liberalization in the case of Vietnam. It may be the case that, with less public services, the farmers become more vulnerable to buyers. Finally, the buyer's marketing power increases, especially if farmers are not unionized to defend their prices. However, these effects are difficult to measure. Nevertheless, in the case of Vietnam, the farmer's price increases between the two regimes. The question to answer is whether the farmer's price increase is due to the world rice price that increased during the same period, and in this case, the positive impact of the liberalization will be limited, or if liberalization works as liberalization proponents predicted.

3.4 Are The Results Robust?

The previous section discussed my empirical model estimation. The main results found are: (i) spatial price competition is significant during both market regimes; (ii) competition is weaker under the liberalized market regime; (iii) proportional transaction costs (PTC) has a significant effect on effective farmer's price during the liberalized regime; (iv) fixed transaction costs (FTC) have a limited effect

on farmer's price.

One weakness of my estimation is the measure of transaction costs. Since no PTC or FTC exists in my data, I used proxies for my estimation. One important question to answer is whether the main results are due to the choice of these proxies. To overcome this obstacle, I used several other proxies of PTC and check if my results still hold.

Using the GIS software, I estimate, besides the population size in a 10 km radius (POP10), several other geographic variables to be used as proxies for PTC. The geographic variables added to the survey data are: (i) the maximum altitude in each community (ALTMAX) , in meters; (ii) the elevation (ELEVATION) in that community; (iii) the distance to the closest main city (DCITY), in kilometers; (iv) the distance to the nearest town (DTOWN), in kilometers; (v) the population in a circle of radius 50 km (POP50); (vi) the distance to the nearest road (DROAD), in kilometers; (vii) the distance to the largest river (DLRIVER); (viii) the distance to the smallest river (SRIVER).

Each of these variables is a good candidate as proxy for PTC. ALTMAX and ELEVATION give an idea on how flat or not is the land in the community. A land with high or lot of hills and mountains will be difficult to access and then the PTC will be high. DCITY and DTOWN measure the closeness of the farmer with a city

and a town. One advantage of being close to a city or a town is the high level of infrastructure that can reduce PTC. The distance to the nearest road is an indicator of how difficult it is to transport his production. Being far away from the road will increase the PTC of the farmer. Since transportation by river of production is an alternative in Vietnam, if the PTC is too high, farmer and buyer can decide to transport the production by river, when possible. Then the distance to the largest river (DLRIVER) or to the smallest one (DSRIVER) may be a way to measure PTC.

For each of these eight proxies of PTC, I rerun the model 1. The results are displayed in Tables 11 under model from 1_2 to model 1_9. For each of the proxy for PTC, table 11 presents two columns. Both columns represent the results of the GS2SLS and the first column represents the regulated market regime (1993) and the second column represents the liberalized market regime (1998). Each of these columns represents the fourth column of the benchmark result of table 9 and 10.

Overall, the benchmark model results hold. For each of these variables, the coefficient for spatial competition (coefficient of DnPn) is positive and significant. The change of the PTC proxy does not alter the existence of spatial price competition. In addition, each of these models shows a weaker spatial competition coefficient for the liberalized market regime (1998). The result regarding the impact of

the farmer own wealth or the neighboring wealth effect also holds. For each of these specifications, the coefficient of the farmer own wealth is significant and positive only in 1997/98. The effect of the neighboring wealth is also negative and significant under both regimes and for all specifications.

Regarding the PTC effect, except for ALTMAX, POP50, DLRIVER and DSRIVER, all the coefficients for PTC have the right sign. Among the proxies with the right sign, only DCITY, DTOWN and DROAD are significant only during the liberalized market. The impact of FTC is once again very limited. Except for the gender, all the FTC proxies are not significant.

To capture the regional differences, I reran the 18 previous models with the REGION variables. Once again, the results of the model hold. I also ran the reduced set of model with key variables for the FTC. The results of these models are presented in table 12 and confirm also the main results found previously.

These tests show the robustness of my results in that price competition in both regimes exists, competition is weaker and transaction costs are at play under the market liberalization regime.

4 Conclusion and next steps

This chapter presents an empirical model to discuss the impact of domestic commodity market liberalization on the farmer's price. This chapter includes the two features observed in practice: a different price for each farmer and farmers' price competition which occurs in each market regime. The empirical model adds three innovations to the literature: (i) it is one of the few models to analyze the commodity market liberalization effect at the farmer's price level; (ii) it tests the effects of spatial price competition, transaction costs and the international environment (timing of liberalization) on the farmer's price by combining household survey data and geographical information data; and (iii) it uses recent developments in the field of spatial econometrics to estimate these effects. Indeed, for the estimation, I use the Generalized Spatial Two-Stage Least Squares (GS2SLS) procedure, developed by Kelejian and Prucha (1998). The advantage of this method is that we don't need to test the model for spatial error and spatial lag correlations since the GS2SLS can be applied to a spatial model that includes both specifications.

The empirical tests are done with two-period household panel data from Vietnam. The sample studied includes all farmers that produce and sell rice during these two surveys. The main findings are the following. First, as predicted by the model, we observe spatial price competition in both market regimes. In addition, we ob-

serve less competition under the market liberalization regime. Second, the estimation shows that proportional transaction costs have an impact on the farmer's price. Finally, the last feature, the international environment around the liberalization, is not tested since it is difficult to capture in the model. However, the observation of the constant, which represents all the other variables not included in the model, move in the same direction as the world price. Since the constant is positive and almost doubles between these two market regimes, it may be the case that the international price positively impacts the farmer's price during the liberalization period. In addition, the timing of the liberalization was good, (during an increasing world price period). It is worth mentioning that the (good or bad) timing of liberalization is not a consequence of the liberalization, but is completely exogenous to this process.

This chapter analyzes the effect of commodity market liberalization and found that price competition and transaction costs at the farmer's level decrease in a favorable international environment. These short-term effects of the liberalization process had a positive impact on the farmer's price, and ultimately, farmers enjoyed a poverty incidence reduction of 39 percent during these two periods. In the case of Vietnam, the liberalization process, which was part of a set of economic reforms, benefits the farmers in the short-term.

What should be the next steps for the farmer? In the case of

Vietnam, the combination of lower transaction costs, an increasing world price and a reduction of price competition benefits the farmer. An important question is whether it is sustainable. Economists agree that agriculture will be profitable in developing countries when productivity rises. Economic history of agricultural countries, which are now developed ones, reveal that agricultural productivity increases with a reduction of the number of farmers. Thus, if today's developing countries plan to benefit from agriculture for welfare improvement, it may be the case that the government in these countries should think of a medium-term reconversion of a large share of the farmers. In the long run, commodity prices are decreasing and production are increasing.

The trend of the commodity world price in the long run is empirically negative. Figure 5 displays the production volume and world price of several commodities (cocoa, coffee, tea, rice, sugar, maize, cotton, and rubber) over a period of 42 years (1960-2002). Except for sugar, the trend of the price of these commodities is decreasing. The world price effect that benefits Vietnam farmers may not be sustainable in the long run.

What should be the next steps for this research? In the future, I plan to transform the model in an agricultural household model to analyze the farmer's welfare following commodity market liberalization. The farm household, which constitutes the majority of

the population in poor countries, offers a good framework to evaluate the impact of trade on welfare in poor countries at the micro level. Agricultural household models are widely used to analyze the behavior of a farm household. It is well recognized that economic decisions, at a household farm level, must be treated as a special case because of its dual role as consumer and producer.[76] In a seminal book, Singh, Squire, and Strauss (1986) presented a comprehensive theory as well as various empirical models of the behavior of the agricultural household.

Obviously, the future of farmers in developing countries depends on the reduction of the number of farmers. The farmers who will leave the farming sector should find jobs in other sectors. This new model should take into account the movement of farmer household members from agriculture job to non agricultural job outside the household. I will also give more power to the farmer for their production sale, which means that farmers will also bear the world price variability, in addition to the production one. Short and long-term effects will be evaluated in the presence of price and production variability. This framework should assist in my analysis of the

[76] As a producer, the household chooses the allocation of land, labor and other inputs for production, and as a consumer, it chooses the allocation of income (from agricultural production profit and off-farm labor wage) to goods and services' consumption. The key point in this framework is the non-reparability of the household' s decision in terms of production and consumption choices. Income is endogenous, as opposed to the pure consumer theory, and production function inputs choice may be interrelated to the choice made for consumption, as opposed to the firm theory.

long-term the sustainability of the market liberalization.

FIGURES

Figure 1: Farmer's production, demand, and supply function

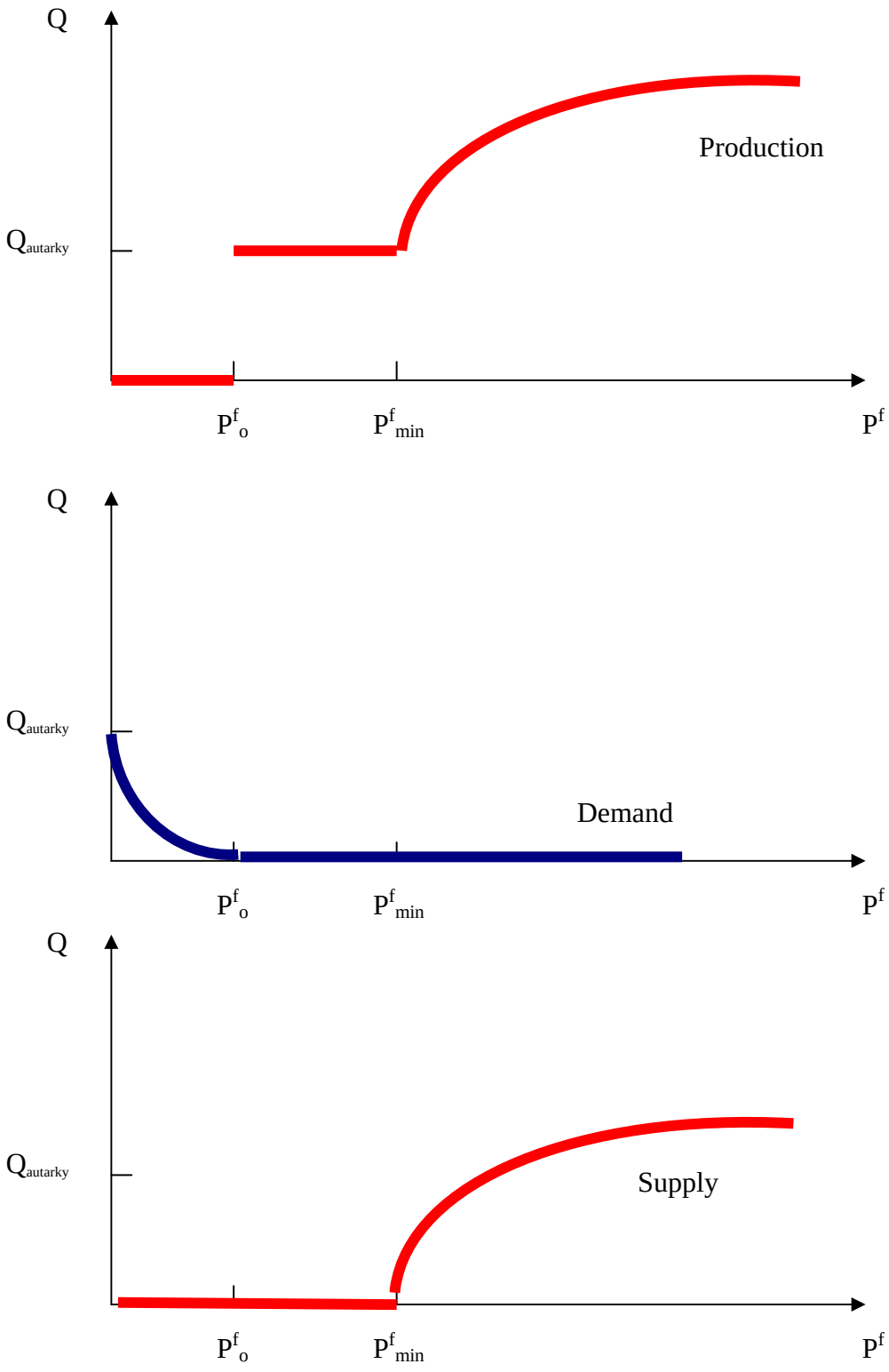
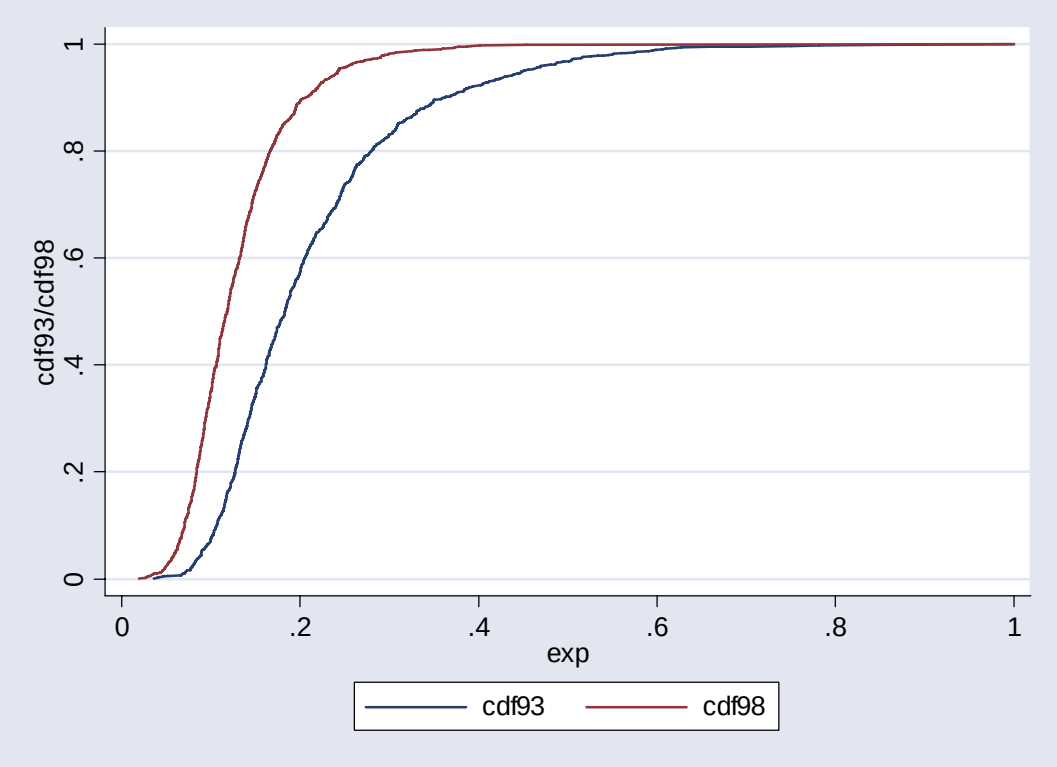
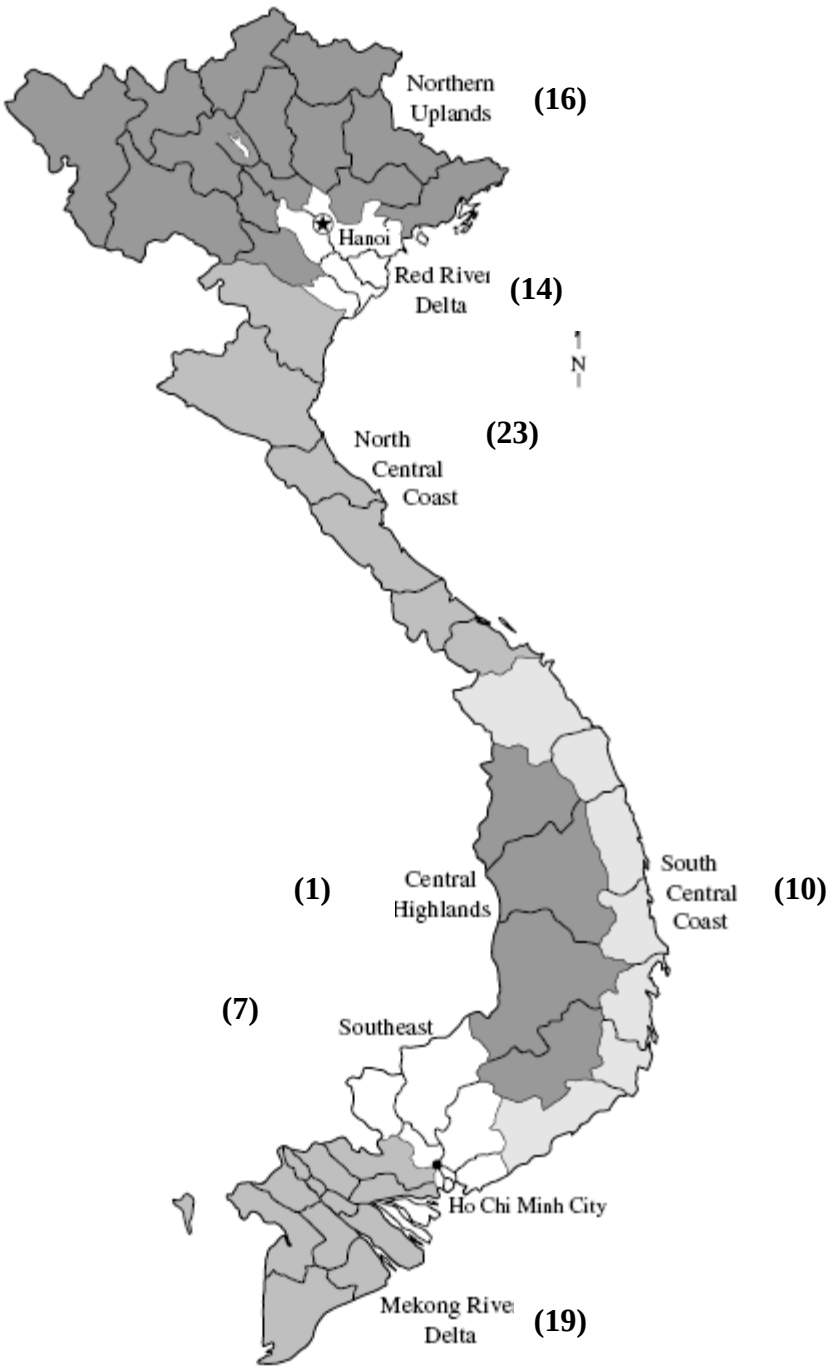


Figure 2: Vietnam 1992/93, 1997/98, Cumulative Density Functions



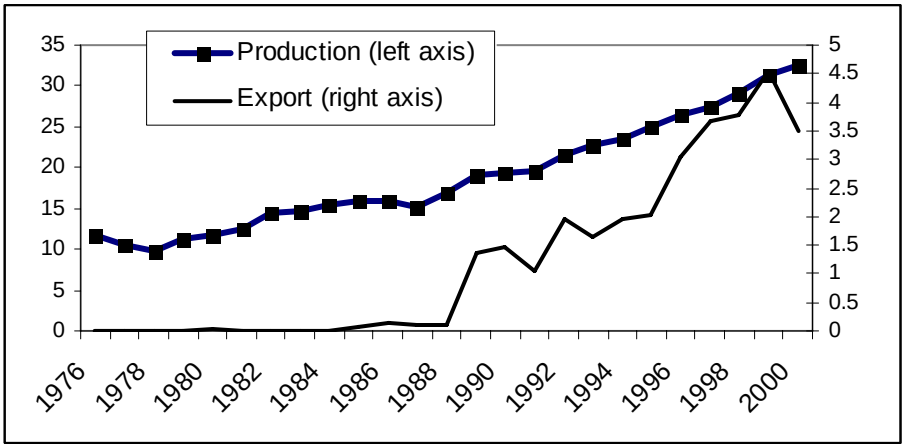
Source: Author, based on Vietnam 1992/93 and 1997/98 Household surveys.

Figure 3— Vietnam, Agro ecological regions.



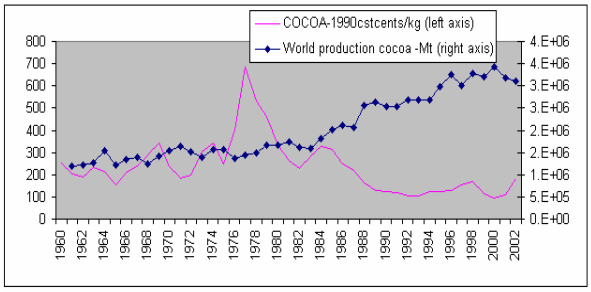
Source: Minot and Goletti (2000) and author.
Note: Figures in parenthesis are the number of communities in each region surveyed and where farmers are located.

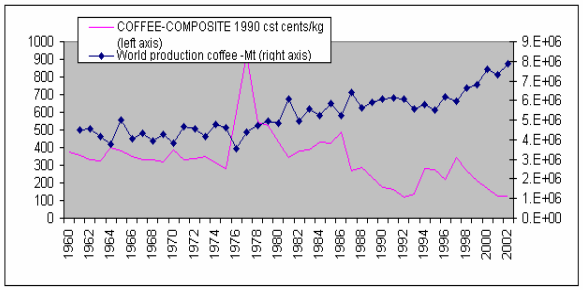
Figure 4—Vietnam, Rice Production and Export, 1976 - 2002 (Millions of tons)

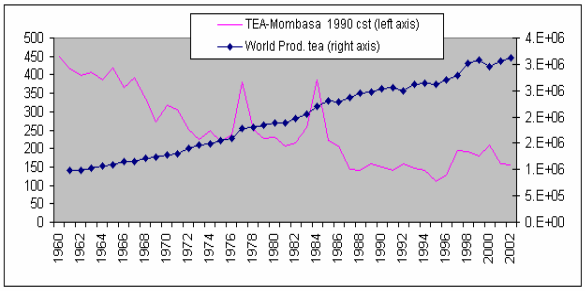


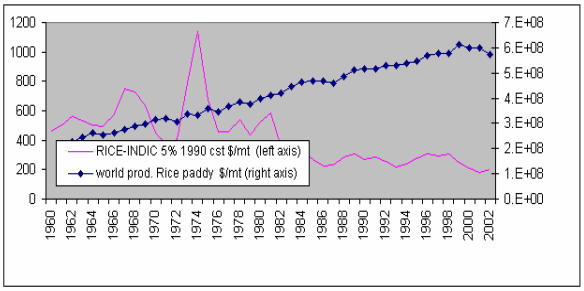
Source: FAO.

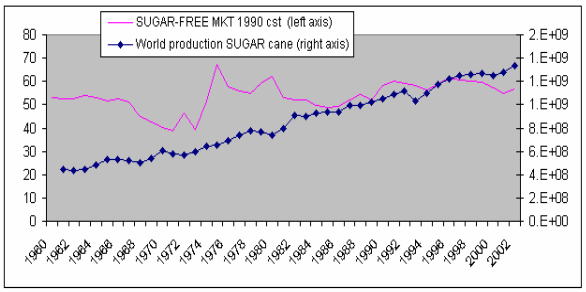
Figure 5---World, Production and Price of the main commodities, 1960 - 2002

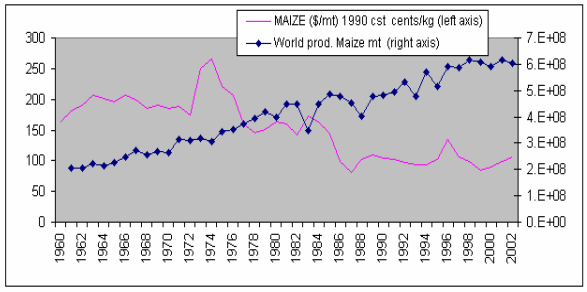


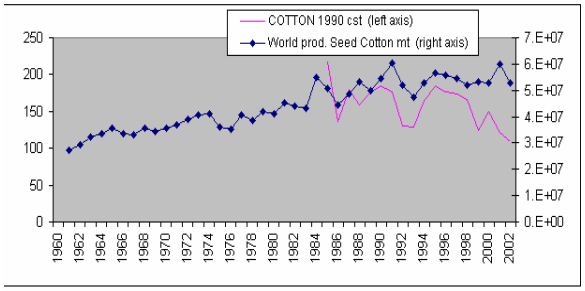


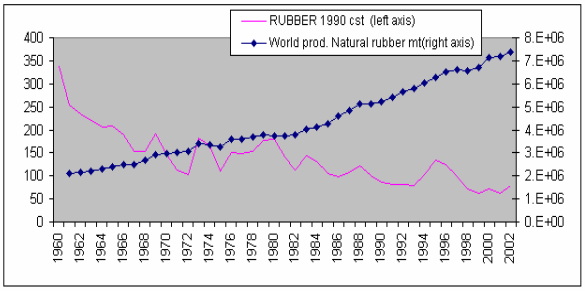












Source: Author, based on The World Bank data..

TABLES

Table 1: Vietnam, Rice's Buyer at Farm Gate, 1992/93 and 1997/98 (%).

	1993	1998
Government	0.5	0.2
Private/Cooperative	0.4	0.1
Individual	99.1	99.7
Total	100.0	100.0

Source: Author based on Vietnam 1992/93 and 1997/98 Household surveys.

Table 2: Vietnam, Selected Poverty and Per Capita Consumption Indicators

	Population share (%)		Headcount index (%)			Real per capita consumption expenditure (US$)		
	1992-93	1997-98	1992-93	1997-98	Change	1992-93	1997-98	Change
Rural	100	100	61.55	37.56	-39.0	109	182	66.4
Region								
Northern Uplands	12.2	12.7	82.3	56.6	-31	87	140	61
North Central	14.2	14.2	84.0	56.9	-32	82	153	86
Red River Delta	32.9	32.5	74.6	38.5	-48	100	184	84
Central Coast	7.6	7.6	46.8	27.3	-42	120	183	52
Central Highlands	0.6	0.6	100.0	100.0	0	36	46	26
South East	6.9	6.9	31.4	14.3	-55	123	269	117
Mekong River Delta	25.7	25.7	34.1	24.1	-29	141	195	38
Ethnic Group								
Vietnamese (Kinh)	90.8	90.8	60.7	35.9	-41	110	186	68
Chinese	0.4	0.5	0.0	0.0	0	141	222	0
Other	8.9	8.8	73.3	57.3	-22	96	136	41
Household size								
small (<=3)	20.6	20.3	58.9	24.3	-59	119	215	81
Medium (3-6 members)	44.7	48.3	63.5	35.0	-45	109	183	67
Large >=6 members	34.7	31.5	60.6	50.0	-18	104	159	53

Education of the head								
None	27.9	8.1	52.1	39.0	-25	119	169	41
Primary	25.9	39.0	60.1	34.8	-42	111	182	64
Lower secondary	27.8	40.8	72.4	41.7	-42	100	181	81
Upper secondary	3.6	8.6	67.6	35.6	-47	107	187	75
Technical	4.2	2.9	62.8	27.6	-56	96	193	101
University	10.5	0.7	58.9	0.0	-100	108	237	119

Source: Author based on Vietnam 1992/93 and 1997/98 Household surveys.

Table 3: Vietnam, Real Rice farmer's price and Area cultivated, 1992/93 and 1997/98

	Real Farmer's rice price (US cent/kg)			Rice area (ha)		
	1992/93	1997/98	Change (%)	1992/93	1997/98	Change (%)
All Observations	16.2	19.1	17.7	10,7	11.8	10.2
Region						
Northern Uplands	16.7	19.3	15	0.6	0.6	17
North Central	14.6	18.8	29	0.6	0.6	-1
Red River Delta	19.7	22.0	12	0.5	0.5	-4
Central Coast	14.0	18.5	32	0.8	0.8	-5
Central Highlands	12.7	18.0	41	0.8	1.0	31
South East	13.7	17.8	30	1.3	2.2	66
Mekong River Delta	13.8	15.8	15	2.2	2.4	8
World Rice Price (UScent/kg)	*22.1*	*30.5*	*38.0*			
FOB price (UScent/kg)	*19.8*	*27.4*	*38.4*			

Source: Author based on Vietnam 1992/93 and 1997/98 Household surveys.

Table 4: Vietnam, household rice production, auto consumption and marketing surplus, 1992/93 and 1997/98

	Rice Production/household (kg)			Home consumption (kg)			Marketing Surplus (kg)		
	1992	1997	Change (%)	1992	1997	Change (%)	1992	1997	Change (%)
All Observations	2331	3290	41.1	1375	1459	6.1	956	1831	91.5
Region									
Northern Uplands	1157	1716	48	862	1302	51	295	414	40
North Central	1343	1763	31	1024	1164	14	319	600	88
Red River Delta	1245	1658	33	949	1102	16	296	556	88
Central Coast	1659	1960	18	1278	1295	1	381	665	75
Central Highlands	942	1579	68	882	1306	48	60	273	355
South East	2559	4678	83	1207	1536	27	1352	3141	132
Mekong River Delta	4998	7033	41	2445	2180	-11	2553	4852	90

Source: Author, based on Vietnam 1992/93 and 1997/98 Household surveys.

Table 5: Vietnam, Rice Revenue: Summary Statistics, 1992/93 and 1997/98 (Thousand LCU)

		1993				1998				Mean change (%)
Region	Obs.	Mean	CV (%)	S	K	Mean	CV (%)	S	K	
Northern Uplands	129	520.4	91.2	1.7	6.7	1054.3	153.3	7.4	71.3	102.6
North Central	330	562.3	82.2	2.3	14.2	1613.3	86.5	2.3	11.1	186.9
Red River Delta	144	500.1	87.4	2.5	11.8	1458.7	83.0	1.3	4.3	191.7
Central Coast	77	564.8	98.2	1.7	6.2	1880.5	83.5	1.3	4.2	232.9
Central Highlands	6	90.8	62.9	1.3	3.4	800.8	82.6	0.8	2.2	781.9
South East	70	2172.1	149.3	2.9	11.7	7886.5	147.0	3.8	21.9	263.1
Mekong River Delta	261	3827.1	120.6	3.6	21.3	10866.4	114.0	2.2	8.8	183.9
Total	1017	1496.4	193.2	5.8	51.6	4342.4	188.5	4.4	27.7	190.2

Source: Author, based on Vietnam 1992/93 and 1997/98 Household surveys.

Notes: Obs.= Observation; CV= Coefficient of Variation; S= Skewness; K= Kurtosis; LCU: Local Currency Unit =Vietnam Dong.

Kurtosis and skewness give additional information on the "shape" of a probability distribution. Kurtosis with a value lower than 3, indicates distribution with fat or short tails; greater than 3 indicates distribution with slim or long tails; the distribution is normally distributed is kurtosis equals 3. For a normally distributed variables skewness equals 0; if it is less than 0, the distribution is left skewed; if it is more than 0 it is right skewed

Table 6: Vietnam, Rice Quantity Sold: Summary Statistics, 1992/93 and 1997/98 (Kg)

		1993				1998				Mean change (%)
Region	Obs	Mean	CV (%)	S	K	Mean	CV (%)	S	K	
Northern Uplands	129	295.2	89.2	1.6	6.2	413.9	186.4	8.8	90.6	40.2
North Central	330	296.2	72.2	1.1	4.3	555.7	83.2	2.2	11.1	87.6
Red River Delta	144	319.2	88.0	2.6	12.9	599.6	87.9	1.5	4.8	87.8
Central Coast	77	381.0	99.0	1.7	5.9	665.5	81.1	1.4	4.5	74.7
Central Highlands	6	59.9	62.9	1.3	3.4	273.0	83.2	0.9	2.4	355.8
South East	70	1351.9	159.3	3.2	13.5	3141.0	145.7	3.9	22.7	132.3
Mekong River Delta	261	2553.3	115.7	3.7	23.1	4852.4	115.3	2.5	11.3	90.0
Total	1017	956.3	197.0	5.7	52.8	1831.2	198.5	4.6	31.2	91.5

Source: Author, based on Vietnam 1992/93 and 1997/98 Household surveys.

Notes: Obs.= Observation; CV= Coefficient of Variation; S= Skewness; K= Kurtosis; LCU: Local Currency Unit =Vietnam Dong.

Kurtosis and skewness give additional information on the "shape" of a probability distribution. Kurtosis with a value lower than 3, indicates distribution with fat or short tails; greater than 3 indicates distribution with slim or long tails; the distribution is normally distributed is kurtosis equals 3. For a normally distributed variables skewness equals 0; if it is less than 0, the distribution is left skewed; if it is more than 0 it is right skewed

Table 7: Vietnam, Rice Unit Price: Summary Statistics, 1992/93 and 1997/98 (Thousand LCU)

		1993				1998				Mean change (%)
Region	Obs	Mean	CV (%)	S	K	Mean	CV (%)	S	K	
Northern Uplands	129	1.8	16.6	3.7	21.3	2.7	21.7	0.9	4.5	47.9
North Central	330	2.0	31.1	4.0	26.8	2.9	22.2	0.7	3.2	50.5
Red River Delta	144	1.6	41.3	0.4	11.6	2.6	22.2	0.8	4.2	61.7
Central Coast	77	1.4	10.9	0.7	7.2	2.8	12.8	-0.6	3.0	90.1
Central Highlands	6	1.5	0.0	1.8	4.2	2.9	13.5	0.6	1.7	92.5
South East	70	1.7	18.5	4.6	31.2	2.5	12.6	0.3	2.5	51.4
Mekong River Delta	261	1.5	64.1	9.4	105.0	2.3	16.0	0.5	3.1	48.7
Total	1017	1.7	38.2	9.1	137.4	2.7	22.0	1.0	4.3	53.6

Source: Author, based on Vietnam 1992/93 and 1997/98 Household surveys.
Notes: Rice unit price is obtained by dividing the farmer revenue from rice by the quantity of rice sold.
Obs.= Observation; CV= Coefficient of Variation; S= Skewness; K= Kurtosis; LCU: Local Currency Unit =Vietnam Dong.
Kurtosis and skewness give additional information on the "shape" of a probability distribution. Kurtosis with a value lower than 3, indicates distribution with fat or short tails; greater than 3 indicates distribution with slim or long tails; the distribution is normally distributed is kurtosis equals 3. For normally distributed variables skewness equals 0; if it is less than 0, the distribution is left skewed; if it is more than 0 it is right skewed

Table 8: Vietnam, Number of communes in the sample by Region

Region	Number of communities
Northern Uplands	16
North Central	23
Red River Delta	14
Central Coast	10
Central Highlands	1
South East	7
Mekong River Delta	19
Total	90

Source: Author, based on Vietnam 1992/93 and 1997/98 Household surveys.
Note: The country has about 10,000 communes.

Table 9: Vietnam, Spatial Competition and Transaction Costs Effect on Prices, 1992/93

Dependent variable: Log of unit rice price

Model 1: 1993	OLS	TSLS	Corrected OLS	GS2SLS
Constant	0.379501	0.376567	0.405466	0.400757
	[0.072047]***	[0.072073]***	[0.074016]***	[0.074059]***
DnPrice	0.009548	0.010415	0.008721	0.01009
	[0.001033]***	[0.001034]***	[0.001285]***	[0.001287]***
Real PC expenditure 1993	0.000025	0.000027	0.000016	0.000018
	[0.000014]*	[0.000014]*	[0.000014]	[0.000014]
Dn(Real PC expenditure)	-0.000004	-0.000004	-0.000003	-0.000004
	[0.000000]***	[0.000000]***	[0.000001]***	[0.000001]***
PTC(+)	0.091007	0.081162	0.061915	0.049474
	[0.059048]	[0.059071]	[0.063022]	[0.063061]
Rice area cultivated (M2)	-0.000001	0	-0.000001	0
	[0.000001]	[0.000001]	[0.000001]	[0.000001]
FTC(++)				
AGE	-0.000095	-0.000138	-0.00005	-0.000089
	[0.000603]	[0.000604]	[0.000603]	[0.000603]
Household size	0.00426	0.00491	0.002896	0.003589
	[0.004369]	[0.004371]	[0.004360]	[0.004362]
Religion				
Other				
Buddist	0.020382	0.021015	0.015632	0.01647
	[0.016055]	[0.016061]	[0.016857]	[0.016866]
SEX				
Female				
Male	0.006465	0.007704	0.000727	0.00203
	[0.026033]	[0.026043]	[0.025943]	[0.025958]

Education				
No education				
Primary	-0.015817	-0.017687	-0.014277	-0.016235
	[0.019371]	[0.019378]	[0.019289]	[0.019301]
Lower Secondary	-0.007377	-0.010122	-0.005979	-0.008798
	[0.021979]	[0.021988]	[0.021917]	[0.021930]
Higher Secondary	0.016394	0.013332	0.022191	0.01912
	[0.040771]	[0.040786]	[0.040727]	[0.040751]
Technical	-0.025446	-0.026625	-0.025344	-0.02646
	[0.022513]	[0.022522]	[0.022458]	[0.022471]
Education of the Spouse				
No education				
Primary	0.019686	0.019397	0.01941	0.019229
	[0.019624]	[0.019631]	[0.019531]	[0.019542]
Lower Secondary	-0.000694	-0.002539	0.004614	0.002532
	[0.020084]	[0.020091]	[0.020097]	[0.020109]
Higher Secondary	-0.028035	-0.029495	-0.020724	-0.02256
	[0.038083]	[0.038096]	[0.038047]	[0.038069]
Technical	-0.000816	-0.000874	0.001249	0.001283
	[0.021557]	[0.021564]	[0.021468]	[0.021481]

Source: Author, based on Vietnam 1992/93 and 1997/98 Household surveys.
Notes: Standard errors in brackets, (*) Significant at 10%; (**) significant at 5%; (***) significant at 1%
(+) PTC=Proportional Transaction Costs is the size of the population in a 10 km radius
(++) Fixed Transaction Costs

Table 9: Vietnam, Spatial Competition and Transaction Costs Effect on Prices (continued) 1992/93

Dependent variable: Log of unit rice price

Model 1: 1993	OLS	TSLS	Corrected OLS	GS2SLS
Owner	0.018636	0.013127	0.023175	0.01712
	[0.018405]	[0.018413]	[0.018766]	[0.018779]
Rice buyer	0.025664	0.026389	0.027441	0.028571
	[0.048137]	[0.048154]	[0.047856]	[0.047884]
INFORMATION	-0.005075	-0.004961	-0.006417	-0.006448
	[0.015113]	[0.015119]	[0.015155]	[0.015164]
MOVE	0.005201	0.003823	0.004905	0.003495
	[0.016315]	[0.016321]	[0.016462]	[0.016472]
MONTH OF SURVEY				
Nov-92				
Dec-92	-0.01129	-0.010191	-0.016533	-0.015146
	[0.038356]	[0.038370]	[0.039947]	[0.039970]
Jan-93	0.018399	0.021145	0.008728	0.01192
	[0.039719]	[0.039734]	[0.040958]	[0.040982]
Feb-93	0.086398	0.08559	0.072819	0.072396
	[0.043454]**	[0.043470]**	[0.044842]	[0.044868]
Mar-93	0.055833	0.057748	0.035658	0.037546
	[0.043623]	[0.043639]	[0.045714]	[0.045740]
Apr-93	0.0412	0.042927	0.032272	0.032679
	[0.040916]	[0.040931]	[0.043499]	[0.043525]
May-93	-0.042227	-0.040109	-0.049214	-0.047889
	[0.039009]	[0.039023]	[0.041530]	[0.041554]
Jun-93	0.010256	0.010722	0.01078	0.010393
	[0.039246]	[0.039260]	[0.041460]	[0.041484]
Jul-93	-0.093293	-0.091203	-0.096168	-0.09518

	[0.053664]*	[0.053684]*	[0.055576]*	[0.055608]*
Aug-93	0.02515	0.029634	0.020741	0.025743
	[0.039683]	[0.039698]	[0.041379]	[0.041404]
Sep-93	-0.059435	-0.057895	-0.061673	-0.060149
	[0.038416]	[0.038430]	[0.040221]	[0.040245]
Observations	1017	1017	1017	1017
ρ	0.06008			
Moran I	15.408			
R-squared	0.78		0.86	

Source: Author, based on Vietnam 1992/93 and 1997/98 Household surveys.
Notes: Standard errors in brackets, (*) Significant at 10%; (**) significant at 5%; (***) significant at 1%
(+) PTC=Proportional Transaction Costs is the size of the population in a 10 km radius
(++) Fixed Transaction Costs

Table 10: Vietnam, Spatial Competition and Transaction Costs Effect on Prices, 1997/98

Dependent variable: Log of unit rice price

Model 1: 1998	OLS	TSLS	Corrected OLS	GS2SLS
Constant	0.684065	0.681228	0.788031	0.788462
	[0.090222]***	[0.090233]***	[0.088928]***	[0.088974]***
DnPrice	0.004764	0.00515	0.00638	0.007727
	[0.000826]***	[0.000826]***	[0.001337]***	[0.001340]***
Real PC expenditure 1993	0.000027	0.000028	0.000015	0.000015
	[0.000006]***	[0.000006]***	[0.000005]***	[0.000005]***
Dn(Real PC expenditure)	-0.000002	-0.000002	-0.000003	-0.000004
	[0.000000]***	[0.000000]***	[0.000001]***	[0.000001]***
PTC(+)	0.234539	0.230807	0.144838	0.136723
	[0.047761]***	[0.047767]***	[0.053952]***	[0.053981]**
Rice area cultivated (M2)	-0.000001	-0.000001	-0.000001	-0.000001
	[0.000000]***	[0.000000]***	[0.000000]**	[0.000000]*
FTC(++)				
AGE	-0.000316	-0.000337	-0.000079	-0.000113
	[0.000506]	[0.000506]	[0.000487]	[0.000487]
Religion				
Other				
Buddist	-0.017225	-0.016006	-0.004714	-0.002317
	[0.015138]	[0.015140]	[0.015733]	[0.015741]
SEX				
Female				
Male	0.046642	0.047158	0.037848	0.039076
	[0.023019]**	[0.023022]**	[0.022005]*	[0.022017]*
Education				

No education				
Primary	-0.046165	-0.046788	-0.038319	-0.039002
	[0.022371]**	[0.022374]**	[0.021729]*	[0.021740]*
Lower Secondary	-0.050751	-0.052594	-0.043423	-0.046303
	[0.025315]**	[0.025319]**	[0.024645]*	[0.024658]*
Higher Secondary	-0.029889	-0.031876	-0.006824	-0.009404
	[0.030611]	[0.030615]	[0.029832]	[0.029847]
Technical	-0.077109	-0.07969	-0.055965	-0.05886
	[0.038181]**	[0.038185]**	[0.036907]	[0.036926]
Education of the Spouse				
No education				
Primary	-0.013103	-0.012701	-0.024562	-0.023608
	[0.017880]	[0.017882]	[0.017104]	[0.017113]
Lower Secondary	0.007132	0.006789	0.003549	0.003239
	[0.019309]	[0.019312]	[0.018570]	[0.018580]
Higher Secondary	-0.0071	-0.007132	-0.005793	-0.004912
	[0.025991]	[0.025994]	[0.025037]	[0.025050]
Technical	0.052362	0.05248	0.048421	0.048228
	[0.042190]	[0.042195]	[0.040397]	[0.040418]

Source: Author, based on Vietnam 1992/93 and 1997/98 Household surveys.
Notes: Standard errors in brackets, (*) Significant at 10%; (**) significant at 5%; (***) significant at 1%
(+) PTC=Proportional Transaction Costs is the size of the population in a 10 km radius
(++) Fixed Transaction Costs

Table 10: Vietnam, Spatial Competition and Transaction Costs Effect on Prices, 1997/98 (continued)

Model 1: 1998	OLS	TSLS	Corrected OLS	GS2SLS
Owner	-0.008597	-0.008163	-0.000573	0.000066
	[0.016478]	[0.016479]	[0.016763]	[0.016771]
Rice buyer	0.130012	0.13121	0.13238	0.135782
	[0.076769]*	[0.076778]*	[0.073609]*	[0.073647]*
INFORMATION	0.014255	0.015006	0.024835	0.026354
	[0.012571]	[0.012573]	[0.012121]**	[0.012128]**
MOVE	0.033446	0.033273	0.022251	0.020877
	[0.015743]**	[0.015745]**	[0.015526]	[0.015534]
MONTH OF SURVEY				
Nov-92				
Dec-92	-0.046335	-0.045839	-0.047969	-0.048112
	[0.027161]*	[0.027164]*	[0.027455]*	[0.027469]*
Jan-93	-0.006919	-0.006396	-0.026582	-0.027271
	[0.022984]	[0.022986]	[0.023115]	[0.023127]
Feb-93	0.054652	0.055583	0.048973	0.049036
	[0.025013]**	[0.025016]**	[0.026753]*	[0.026766]*
Mar-93	0.056559	0.057478	0.046563	0.04675
	[0.029703]*	[0.029707]*	[0.033736]	[0.033753]
Apr-93	0.090506	0.091002	0.022385	0.020296
	[0.025564]***	[0.025567]***	[0.029371]	[0.029386]
May-93	0.120354	0.120947	0.086562	0.08588
	[0.024263]***	[0.024266]***	[0.026561]***	[0.026575]***
Jun-93	0.198322	0.198469	0.153164	0.152306
	[0.025622]***	[0.025625]***	[0.029829]***	[0.029844]***
Jul-93	0.208712	0.208609	0.158812	0.157683

	[0.023911]***	[0.023914]***	[0.027972]***	[0.027987]***
Aug-93	0.154536	0.153824	0.151512	0.150343
	[0.026664]***	[0.026667]***	[0.030521]***	[0.030537]***
Sep-93	-0.012177	-0.012463	-0.032071	-0.03372
	[0.026085]	[0.026088]	[0.024701]	[0.024713]
Observations	1017	1017	1017	1017
ρ	0.029852			
Moran I	14.535			
R-squared	0.94		0.97	

Source: Author, based on Vietnam 1992/93 and 1997/98 Household surveys.
Notes: Standard errors in brackets, (*) Significant at 10%; (**) significant at 5%; (***) significant at 1%
(+) PTC=Proportional Transaction Costs is the size of the population in a 10 km radius
(++) Fixed Transaction Costs

Table 11: Vietnam, Spatial Competition and Transaction Costs Effect on Prices: Alternative Measures of Transaction Costs (PTC)

(only the most relevant variables are presented)

Dependent variable: Log of unit rice price	Model 1_2: Altmax		Model 1_3: Elevation		Model 1_4: DMCITY	
	1993	1998	1993	1998	1993	1998
Constant	0.400459	0.79423	0.403378	0.79971	0.415025	0.785012
	[0.074554]***	[0.089104]***	[0.074332]***	[0.089253]***	[0.074769]***	[0.089673]***
DnPrice	0.010252	0.007938	0.010289	0.008273	0.009971	0.008363
	[0.001316]***	[0.001475]***	[0.001246]***	[0.001485]***	[0.001338]***	[0.001422]***
Real PC expenditure 1993	0.000017	0.000015	0.000018	0.000015	0.000016	0.000016
	[0.000014]	[0.000006]***	[0.000014]	[0.000006]***	[0.000014]	[0.000006]***
Dn(Real PC expenditure)	-0.000004	-0.000004	-0.000004	-0.000004	-0.000004	-0.000004
	[0.000001]***	[0.000001]***	[0.000001]***	[0.000001]***	[0.000001]***	[0.000001]***
PTC(+)	0.000027	0.000009	-0.000016	-0.000019	-0.000996	-0.000692
	[0.000046]	[0.000040]	[0.000036]	[0.000028]	[0.000759]	[0.000665]**
Rice area cultivated (M2)	0	-0.000001	0	-0.000001	0	-0.000001
	[0.000001]	[0.000000]*	[0.000001]	[0.000000]*	[0.000001]	[0.000000]**
FTC(++)						
AGE	-0.000062	-0.000123	-0.000074	-0.000152	-0.000051	-0.00014
	[0.000603]	[0.000489]	[0.000603]	[0.000491]	[0.000602]	[0.000489]
Religion						
Other						
Buddist	0.016554	-0.005018	0.016218	-0.005303	0.017424	-0.006088
	[0.017002]	[0.015803]	[0.016857]	[0.015817]	[0.017024]	[0.015856]
SEX						
Female						
Male	0.002143	0.040923	0.002559	0.041011	0.001159	0.041974
	[0.025941]	[0.022057]*	[0.025978]	[0.022059]*	[0.025918]	[0.022078]*

Education						
No education						
Primary	-0.015176	-0.037365	-0.015606	-0.0378	-0.016536	-0.038912
	[0.019298]	[0.021791]*	[0.019305]	[0.021793]*	[0.019282]	[0.021816]*
Lower Secondary	-0.006829	-0.043767	-0.007357	-0.044094	-0.00831	-0.045676
	[0.021845]	[0.024699]*	[0.021851]	[0.024704]*	[0.021836]	[0.024747]*
Higher Secondary	0.021964	-0.005539	0.019359	-0.006233	0.019602	-0.007442
	[0.040764]	[0.029904]	[0.040767]	[0.029907]	[0.040709]	[0.029926]
Technical	-0.026328	-0.060101	-0.027029	-0.061322	-0.026923	-0.060389
	[0.022473]	[0.037020]	[0.022495]	[0.037036]*	[0.022449]	[0.037014]
Owner	0.017743	-0.002108	0.016839	-0.001494	0.019676	-0.001538
	[0.018823]	[0.016836]	[0.018767]	[0.016799]	[0.018869]	[0.016799]
Rice buyer	0.029372	0.137937	0.028407	0.138317	0.030305	0.140794
	[0.047859]	[0.073837]*	[0.047937]	[0.073842]*	[0.047809]	[0.073858]*
INFORMATION	-0.007055	0.024135	-0.006818	0.024447	-0.006518	0.024834
	[0.015163]	[0.012165]**	[0.015160]	[0.012165]**	[0.015155]	[0.012160]**
MOVE	0.002792	0.019658	0.003147	0.019821	0.003464	0.019457
	[0.016473]	[0.015566]	[0.016460]	[0.015557]	[0.016469]	[0.015560]

Source: Author, based on Vietnam 1992/93 and 1997/98 Household surveys.
Notes: Standard errors in brackets, (*) Significant at 10%; (**) significant at 5%; (***) significant at 1%
(+) PTC=Proportional Transaction Costs is the size of the population in a 10 km radius
(++) Fixed Transaction Costs

Table 11: Vietnam, Spatial Competition and Transaction Costs Effect on Prices: Alternative Measures of Transaction Costs (PTC)- (continued)

(only the most relevant variables are presented)

	Model 1_5: DNTOWN		Model 1_6: POP50		Model 1_7: ROAD	
	1993	1998	1993	1998	1993	1998
Constant	0.398452	0.83161	0.414136	0.779814	0.416133	0.819425
	[0.074709]***	[0.089397]***	[0.074676]***	[0.089226]***	[0.074733]***	[0.088884]***
DnPrice	0.01026	0.008867	0.010553	0.008245	0.010046	0.007458
	[0.001276]***	[0.001365]***	[0.001359]***	[0.001391]***	[0.001317]***	[0.001434]***
Real PC expenditure	0.000018	0.000015	0.000017	0.000015	0.000018	0.000016
	[0.000015]	[0.000005]***	[0.000014]	[0.000005]***	[0.000015]	[0.000005]***
Dn(Real PC expenditure)	-0.000004	-0.000004	-0.000004	-0.000004	-0.000004	-0.000004
	[0.000001]***	[0.000001]***	[0.000001]***	[0.000001]***	[0.000001]***	[0.000001]***
PTC(+)	-0.0202	-0.012718	-0.002938	0.003421	-0.003108	-0.003707
	[0.005502]	[0.003860]***	[0.002020]	[0.001575]**	[0.001442]	[0.001165]***
Rice area cultivated (M2)	0	-0.000001	0	-0.000001	0	-0.000001
	[0.000001]	[0.000000]	[0.000001]	[0.000000]**	[0.000001]	[0.000000]
FTC(++)						
AGE	-0.000066	-0.000238	-0.000179	-0.00009	-0.00019	-0.000289
	[0.000603]	[0.000488]	[0.000608]	[0.000488]	[0.000608]	[0.000489]
Religion						
Other						
Buddist	0.015728	-0.007166	0.016632	-0.005589	0.017668	-0.003333
	[0.016963]	[0.015734]	[0.017008]	[0.015765]	[0.016990]	[0.015717]
SEX						
Female						
Male	0.002838	0.040457	0.003405	0.042841	0.002249	0.036631
	[0.025963]	[0.021968]*	[0.025945]	[0.022034]*	[0.025913]	[0.021983]*

Education						
No education						
Primary	-0.015857	-0.042464	-0.016995	-0.04221	-0.017042	-0.03608
	[0.019301]	[0.021741]*	[0.019297]	[0.021840]*	[0.019292]	[0.021680]*
Lower Secondary	-0.007412	-0.049246	-0.009014	-0.049676	-0.008251	-0.041765
	[0.021854]	[0.024649]**	[0.021861]	[0.024786]**	[0.021828]	[0.024582]*
Higher Secondary	0.020447	-0.01037	0.017815	-0.010595	0.0185	-0.003625
	[0.040741]	[0.029802]	[0.040771]	[0.029912]	[0.040722]	[0.029753]
Technical	-0.02673	-0.062291	-0.028673	-0.061336	-0.028581	-0.057872
	[0.022479]	[0.036864]*	[0.022500]	[0.036948]*	[0.022488]	[0.036822]
Owner	0.017045	0.001698	0.019631	0.001143	0.018375	0.001455
	[0.018800]	[0.016759]	[0.018868]	[0.016814]	[0.018810]	[0.016736]
Rice buyer	0.029356	0.131505	0.031866	0.136894	0.030991	0.139426
	[0.047887]	[0.073556]*	[0.047840]	[0.073700]*	[0.047818]	[0.073441]*
INFORMATION	-0.00667	0.025394	-0.006496	0.025398	-0.006946	0.02434
	[0.015173]	[0.012105]**	[0.015160]	[0.012139]**	[0.015147]	[0.012096]**
MOVE	0.002753	0.017249	0.002523	0.019213	0.001891	0.020659
	[0.016465]	[0.015512]	[0.016471]	[0.015532]	[0.016468]	[0.015477]

Source: Author, based on Vietnam 1992/93 and 1997/98 Household surveys.
Notes: Standard errors in brackets, (*) Significant at 10%; (**) significant at 5%; (***) significant at 1%
(+) PTC=Proportional Transaction Costs, specify in the heading, (++) Fixed Transaction Costs

Table 11: Vietnam, Spatial Competition and Transaction Costs Effect on Prices: Alternative Measures of Transaction Costs (PTC)-Robustness Test (end)

(only the most relevant variables are presented)

	Model 1_8: DLRIVER		Model 1_9: DSRIVER	
	1993	1998	1993	1998
Constant	0.4038	0.791428	0.414032	0.796628
	[0.074353]***	[0.089551]***	[0.074673]***	[0.088906]***
DnPrice	0.010176	0.008088	0.010265	0.007956
	[0.001305]***	[0.001446]***	[0.001323]***	[0.001458]***
Real PC expenditure 1993	0.000017	0.000015	0.000018	0.000015
	[0.000014]	[0.000006]***	[0.000014]	[0.000006]***
Dn(Real PC expenditure)	-0.000004	-0.000004	-0.000004	-0.000004
	[0.000001]***	[0.000001]***	[0.000001]***	[0.000001]***
PTC(+)	-0.0002	0.000288	-0.000304	0.000272
	[0.000730]	[0.000689]	[0.000223]	[0.000171]
Rice area cultivated (M2)	0	-0.000001	0	-0.000001
	[0.000001]	[0.000000]*	[0.000001]	[0.000000]*
FTC(++)				
AGE	-0.000072	-0.000098	-0.000066	-0.000127
	[0.000604]	[0.000493]	[0.000602]	[0.000489]
Religion				
Other				
Buddist	0.016492	-0.005151	0.015787	-0.005282
	[0.016969]	[0.015823]	[0.016968]	[0.015784]
SEX				
Female				
Male	0.002073	0.041099	0.004827	0.038455
	[0.025968]	[0.022061]*	[0.026008]	[0.022087]*
Education				

No education				
Primary	-0.015836	-0.03726	-0.014729	-0.037921
	[0.019306]	[0.021807]*	[0.019280]	[0.021763]*
Lower Secondary	-0.007515	-0.043076	-0.006633	-0.044105
	[0.021881]	[0.024803]*	[0.021825]	[0.024671]*
Higher Secondary	0.020414	-0.004898	0.020723	-0.008153
	[0.040746]	[0.030008]	[0.040700]	[0.029900]
Technical	-0.026575	-0.059882	-0.026999	-0.060985
	[0.022474]	[0.037036]	[0.022454]	[0.036966]*
Owner	0.017419	-0.002083	0.017775	-0.001962
	[0.018805]	[0.016817]	[0.018817]	[0.016772]
Rice buyer	0.029527	0.138657	0.029777	0.137415
	[0.047881]	[0.073849]*	[0.047817]	[0.073747]*
INFORMATION	-0.006903	0.024046	-0.006546	0.023988
	[0.015163]	[0.012183]**	[0.015156]	[0.012147]**
MOVE	0.002865	0.019838	0.002478	0.01935
	[0.016466]	[0.015561]	[0.016465]	[0.015537]

Source: Author, based on Vietnam 1992/93 and 1997/98 Household surveys.
Notes: Standard errors in brackets, (*) Significant at 10%; (**) significant at 5%; (***) significant at 1%
(+) PTC=Proportional Transaction Costs, specify in the heading; (++) Fixed Transaction Costs

Table 12: Vietnam, Spatial Competition and Transaction Costs Effect on Prices: Reduced Model

Dependent variable: Log of unit rice price	Model 2_2: Altmax		Model 2_3: Elevation		Model 2_4: DMCITY	
	1993	1998	1993	1998	1993	1998
Constant	0.449838	0.984386	0.452812	0.996203	0.470803	1.00874
	[0.062354]***	[0.042042]***	[0.062374]***	[0.041780]***	[0.062521]***	[0.042901]***
DnPrice	0.008368	0.001509	0.008148	0.003562	0.007878	0.00181
	[0.001811]***	[0.002324]	[0.001740]***	[0.002272]	[0.001774]***	[0.002297]
Real PC expenditure	0.000011	0.000019	0.000012	0.000019	0.000011	0.000018
	[0.000013]	[0.000005]***	[0.000013]	[0.000005]***	[0.000013]	[0.000005]***
Dn(Real PC expenditure)	-0.000003	-0.000001	-0.000003	-0.000002	-0.000003	-0.000001
	[0.000001]***	[0.000001]	[0.000001]***	[0.000001]**	[0.000001]***	[0.000001]
PTC(+)	0.000006	0.000032	-0.000005	-0.000038	-0.001359	-0.001152
	[0.000045]	[0.000040]	[0.000033]	[0.000028]	[0.000754]*	[0.000649]*
rice area cultivated (M2)	-0.000001	0.017751	-0.000001	0.018354	-0.000001	0.018435
	[0.000001]	[0.012691]	[0.000001]	[0.012645]	[0.000001]	[0.012660]
FTC(++)						
AGE	-0.000008	-0.000251	-0.000012	-0.000271	0.000032	-0.000215
	[0.000558]	[0.000498]	[0.000559]	[0.000497]	[0.000557]	[0.000497]
SEX						
Female						
Male	0.001204	-0.019628	0.001333	-0.020213	-0.000094	-0.018995
	[0.018340]	[0.016537]	[0.018344]	[0.016498]	[0.018321]	[0.016504]
Education						
No education						
Primary	-0.004367	0.016323	-0.004065	0.01613	-0.005593	0.015962
	[0.019064]	[0.014943]	[0.019064]	[0.014870]	[0.019047]	[0.014891]
Lower Secondary	0.004134	-0.041831	0.004656	-0.042743	0.002962	-0.040534

	[0.021164]	[0.022417]*	[0.021168]	[0.022328]*	[0.021157]	[0.022365]*
Higher Secondary	0.041642	-0.04272	0.041702	-0.042797	0.040006	-0.040726
	[0.040059]	[0.025563]*	[0.040053]	[0.025488]*	[0.040002]	[0.025517]
Technical	-0.025976	-0.005902	-0.025951	-0.006689	-0.026553	-0.004713
	[0.021956]	[0.031311]	[0.021970]	[0.031219]	[0.021928]	[0.031219]
INFORMATION	-0.001023	-0.078728	-0.000954	-0.078103	-0.000531	-0.077952
	[0.014852]	[0.037909]**	[0.014854]	[0.037775]**	[0.014830]	[0.037799]**
MOVE	0.011519	-0.029891	0.01193	-0.027883	0.012478	-0.028052
	[0.016156]	[0.017070]*	[0.016157]	[0.016976]	[0.016132]	[0.016955]*
rice buyer 1993	0.03786	0.019421	0.037626	0.020209	0.039018	0.018963
	[0.047190]	[0.015701]	[0.047275]	[0.015658]	[0.047129]	[0.015656]

Source: Author, based on Vietnam 1992/93 and 1997/98 Household surveys.

Notes: Standard errors in brackets, (*) Significant at 10%; (**) significant at 5%; (***) significant at 1%

(+) PTC=Proportional Transaction Costs is the size of the population in a 10 km radius

(++) Fixed Transaction Costs

Table 12: Vietnam, Spatial Competition and Transaction Costs Effect on Prices: Reduced Model -(continued)

	Model 2_5: DNTOWN		Model 2_6: POP10		Model 2_7: POP50	
	1993	1998	1993	1998	1993	1998
Constant	0.450154	1.016373	0.446548	0.951912	0.462661	0.976971
	[0.062335]***	[0.041663]***	[0.061746]***	[0.041198]***	[0.062206]***	[0.042410]***
DnPrice	0.008108	0.003566	0.007979	0.000754	0.008949	0.003112
	[0.001670]***	[0.002259]	[0.001730]***	[0.002264]	[0.001745]***	[0.002260]
Real PC expenditure	0.000012	0.000019	0.000012	0.000018	0.000013	0.000018
	[0.000013]	[0.000005]***	[0.000013]	[0.000005]***	[0.000013]	[0.000005]***
Dn(Real PC expenditure)	-0.000003	-0.000002	-0.000003	-0.000001	-0.000003	-0.000002
	[0.000001]***	[0.000001]*	[0.000001]***	[0.000001]	[0.000001]***	[0.000001]*
PTC(+)	0.00043	-0.016876	0.074706	0.351335	-0.002925	0.002385
	[0.004921]	[0.003983]***	[0.063081]	[0.053021]***	[0.001987]	[0.001634]
rice area cultivated (M2)	-0.000001	0.019269	-0.000001	0.022061	-0.000001	0.018912
	[0.000001]	[0.012556]	[0.000001]	[0.012463]*	[0.000001]	[0.012654]
FTC(++)						
AGE	-0.000006	-0.000339	-0.000029	-0.000233	-0.000105	-0.00021
	[0.000558]	[0.000493]	[0.000558]	[0.000489]	[0.000561]	[0.000497]
SEX						
Female						
Male	0.001625	-0.020472	0.000766	-0.010941	0.00102	-0.019518
	[0.018349]	[0.016371]	[0.018345]	[0.016262]	[0.018319]	[0.016497]
Education						
No education						
Primary	-0.003852	0.017479	-0.005324	0.015703	-0.005554	0.017102
	[0.019075]	[0.014766]	[0.019078]	[0.014639]	[0.019050]	[0.014883]
Lower Secondary	0.004976	-0.048227	0.002021	-0.047117	0.001978	-0.045783
	[0.021188]	[0.022204]**	[0.021247]	[0.021966]**	[0.021175]	[0.022460]**

Higher Secondary	0.041624	-0.049092	0.039004	-0.051213	0.036692	-0.046298
	[0.040075]	[0.025332]*	[0.040071]	[0.025071]**	[0.040113]	[0.025622]*
Technical	-0.025776	-0.012351	-0.025983	-0.016189	-0.027963	-0.008804
	[0.021977]	[0.030996]	[0.021954]	[0.030695]	[0.021977]	[0.031276]
INFORMATION	-0.000748	-0.079715	-0.000068	-0.072038	-0.000668	-0.078485
	[0.014874]	[0.037491]**	[0.014859]	[0.037172]*	[0.014837]	[0.037779]**
MOVE	0.012162	-0.027896	0.013167	-0.018451	0.011146	-0.027776
	[0.016145]	[0.016822]*	[0.016174]	[0.016706]	[0.016136]	[0.016974]
rice buyer 1993	0.038515	0.015806	0.036494	0.024984	0.042429	0.019298
	[0.047301]	[0.015552]	[0.047217]	[0.015391]	[0.047253]	[0.015648]

Source: Author, based on Vietnam 1992/93 and 1997/98 Household surveys.
Notes: Standard errors in brackets, (*) Significant at 10%; (**) significant at 5%; (***) significant at 1%
(+) PTC=Proportional Transaction Costs is the size of the population in a 10 km radius
(++) Fixed Transaction Costs

Table 12: Vietnam, Spatial Competition and Transaction Costs Effect on Prices: Reduced Model - (end)

	Model 2_8: ROAD		Model 2_9: DLRIVER		Model 2_10: DSRIVER	
	1993	1998	1993	1998	1993	1998
Constant	0.467456	1.015427	0.45267	0.985467	0.449913	0.99118
	[0.062104]***	[0.041780]***	[0.062407]***	[0.042332]***	[0.061669]***	[0.041454]***
DnPrice	0.008132	0.003105	0.008047	0.002039	0.008588	0.001909
	[0.001882]***	[0.002214]	[0.001839]***	[0.002286]	[0.001785]***	[0.002284]
Real PC expenditure	0.000014	0.000019	0.000011	0.000019	0.000012	0.000019
	[0.000013]	[0.000005]***	[0.000013]	[0.000005]***	[0.000013]	[0.000005]***
Dn(Real PC expenditure)	-0.000003	-0.000002	-0.000003	-0.000001	-0.000003	-0.000001
	[0.000001]***	[0.000001]**	[0.000001]***	[0.000001]	[0.000001]***	[0.000001]
PTC(+)	-0.002849	-0.004476	-0.000049	0.000345	-0.000331	0.000431
	[0.001405]**	[0.001157]***	[0.000737]	[0.000654]	[0.000216]	[0.000178]**
rice area cultivated (M2)	-0.000001	0.018588	-0.000001	0.017471	-0.000001	0.0171
	[0.000001]	[0.012565]	[0.000001]	[0.012700]	[0.000001]	[0.012643]
FTC(++)						
AGE	-0.000147	-0.000382	-0.00001	-0.000209	0.000013	-0.000307
	[0.000561]	[0.000495]	[0.000559]	[0.000501]	[0.000557]	[0.000497]
SEX						
Female						
Male	0.000606	-0.017809	0.001118	-0.019983	0.001965	-0.020063
	[0.018286]	[0.016396]	[0.018352]	[0.016529]	[0.018313]	[0.016479]
Education						
No education						
Primary	-0.0067	0.013897	-0.00425	0.016304	-0.004166	0.015588
	[0.019040]	[0.014790]	[0.019070]	[0.014903]	[0.019029]	[0.014869]
Lower Secondary	0.002456	-0.040641	0.004496	-0.041771	0.004152	-0.04322
	[0.021136]	[0.022185]*	[0.021203]	[0.022381]*	[0.021130]	[0.022310]*

Higher Secondary	0.038977	-0.040938	0.042049	-0.041039	0.040234	-0.042628
	[0.039985]	[0.025316]	[0.040048]	[0.025625]	[0.039996]	[0.025453]*
Technical	-0.028043	-0.004136	-0.025911	-0.004025	-0.026494	-0.009148
	[0.021924]	[0.030994]	[0.021954]	[0.031384]	[0.021929]	[0.031193]
INFORMATION	-0.001273	-0.075346	-0.001031	-0.077274	-0.000177	-0.077099
	[0.014817]	[0.037528]**	[0.014850]	[0.037858]**	[0.014843]	[0.037743]**
MOVE	0.010346	-0.025813	0.011665	-0.028494	0.011311	-0.027877
	[0.016136]	[0.016869]	[0.016158]	[0.016975]*	[0.016137]	[0.016931]*
Rice buyer 1993	0.038164	0.018946	0.037794	0.020141	0.037892	0.019584
	[0.047067]	[0.015548]	[0.047184]	[0.015684]	[0.047129]	[0.015628]

Source: Author, based on Vietnam 1992/93 and 1997/98 Household surveys.

Notes: Standard errors in brackets, (*) Significant at 10%; (**) significant at 5%; (***) significant at 1%

(+) PTC=Proportional Transaction Costs, specify in the heading

(++) Fixed Transaction Costs

7 Appendix A: Overview of the Economy and the Rice Sector of Vietnam

1986 is the beginning of the "economic renovation"[77] in Vietnam. These reforms aimed to move the economy from a centrally planned socialist economy to a more market-oriented economy, thus allowing the market to play a greater role in the allocation of economic resources. After a slow start, the renovations were accelerated in the mid-1990s. The core elements of these policies that made it a success were a combination of liberalization, stabilization, institutional changes and structural reforms (Kokko, 1997). The main components of these reforms were the change of the administrative controls by economics ones, the promotion of agriculture (decollectivization of land, liberalization of fertilizer prices,...), the removal of price controls on many goods, the liberalization of internal trade, the restriction of the role of state owned firms in the economy, the replacement of non-tariff barriers with tariffs and the openness to foreign investment.

One of the core achievements of these reforms is the entrance of Vietnam into the world economy. Before 1986, the country traded mainly with the Council of Mutual Economic Assistance[78] - CMEA -

[77] or doi moi

[78] The CMEA countries include the former Soviet Union, Eastern European socialist countries and Cuba.

countries. International trade was regulated by licences and quotas., and the existence of multiple exchange rates made it hard for international trade to be profitable. With the economic renovation, the country introduced custom tariffs for the first time in 1988, which allowed private firms to export in any country without necessarily having met their export target in the CMEA countries. Quotas, duties and export taxes were lowered and multiple exchange rates had been unified and were closer to the market rate. Additionally, the country introduced the Harmonized System (HS) in 1992 and published its annual tariff schedules since then. Vietnam moved deeper in the globalization of its economy via regional and multilateral trading agreements. It became a member of several regional trading groups including Association of South East Asian Nations (ASEAN), the economic Free Trade Area (AFTA) and become a GATT observer by 1994[79].

The success of these economic reforms were reflected in the high average annual growth rate (7%) between 1990 and 2000. Sound macroeconomics policies stabilized the hyperinflation of the 1980s, even after the collapse of the CMEA countries. Table A.1 displays selected macroeconomics indicators for Vietnam from 1991 to 2000. Inflation dropped from 83 percent in 1991 to 4% in 1999. The ratio of trade over GDP increased from 67 percent in 1991 to 97 percent in

[79] also, in 1994, the USA lifted the economic embargo, which opened the American market to the country.

2000. The share of oil in the total export fell steadily from 30 percent to 13 percent between 1992 and 1998. The share of the textile and garment sectors in total trade increased from 7.7 percent in 1992 to 15.5 percent in 1998. Agriculture, especially the rice sector, was another fast and impressive growing export. Before the reforms, Vietnam was a net importer of rice and by 1997, the country turned out to be the second largest exporter of rice after Thailand. The success story of the rice sector is mainly due to the agricultural reforms that are discussed below.

Agricultural reforms began in Vietnam after the reunification of the country in 1975 but were a failure[80]. Before 1981, land belonged to the State and a cooperative management board controlled the agricultural production. Following the direction of the board, each farmer was attributed a work-point which determine his income. The collectivization was more successful in the North than in the South and overall the system failed to achieve government objective and reach rapid productivity growth, mainly because of the lack of producer incentives and disrupt market mechanisms (Pingali and Xuan, 1992).

Table A.2 shows the rice production performance between 1966 and 2000. The introduction of the contract method between 1981 and 1987 improved significantly output growth (3.14%) compared

[80] none of the 15 production targets were met and food production was 31 percent below target and fell in per capita terms (Minot and Goletti, 2000)

to 0.46% in the period before. However, several problems subsisted (failure of the government to collect all the production, lack of land tenure security) and changes were undertaken in 1988 to overcome these shortcomings.[81]

During the "Doi Moi" in the mid 80s, the first resolution was to move away from the collectivization of farming and to give more rights (powers) to the farmers. The purchase, ownership and selling of agricultural products by the farmers were now allowed. Since one objective of the government was to give more power to the market, mandatory purchases of agricultural products based on government sanctions were abolished and more responsibility was given to private traders.

Even though Vietnam is one of the largest rice exporters, only less than a quarter of its area is agricultural land, 50 percent of which is devoted to rice production. Due to the shape of the country, weather and rice seasons are different in the South and in the North. In the South, there are two seasons including a wet (May to November) and a dry (December to May). In the irrigated areas, there are three rice crops per year (Summer-Autumn, Autumn-Winter and Winter-Spring) and there is only one crop in the rained areas (the "main wet season"). The rice deficit north region has four seasons and double cropping is the norm. The rice production in this region are

[81] Resolution #10

the Winter-crop, the Main-season-crop and the Summer-autumn.

Two regions produced more than two-thirds of the rice production in the country: the Red River Delta in the North and the Mekong Delta River in the South. In the Red River Delta region, farms are small (0.25 hectare on average) and intensively cultivated and the cultivativation is more labor-intensive (246 person-days-season per hectare in 1998). About 95 percent of the rural households grew rice on 81 percent of the arable land and labor hired for the rice production represented 5 percent of the total labor use in the Red River Delta. This region represented 18 percent of the country rice production. In the south, the Mekong Delta utilized large scale rice cultivation in larger farms (1.26 hectares on average), and a lower cropping intensity, which accounted for more than half of the country rice production. Rice cultivation in this region is less labor-intensive with 96 person-days-season per hectare in 1998 and the labor hired the Mekong Delta represented about 33 to 39 percent of the total labor in the rice production (IFPRI, 1996). The remaining regions in the country, five, are lacking in terms of rice production.

The market structure of a commodity, like rice, is much more complicated than for cocoa or coffee. Besides being a tradable good, rice is also subject to internal consumption. Thus, the government has to find the right balance between export to generate foreign cur-

rency and auto-consumption to satisfy basic needs. The rice market structure includes farm-level marketing, milling sector, wholesale marketing, domestic retail marketing, and the rice export. A 1996 IFPRI survey found that more than 95 percent of paddy purchases were done by private assemblers. Assemblers sell their paddy to millers (Mekong Delta) or to wholesalers after they have the paddy milled (other regions). The rice milling sector processes the paddy and sell their output to the wholesalers or to the state owned enterprises. Wholesale marketing is an important step linking other categories of traders. It includes private wholesalers and SOEs. The latter have the legal monopoly of exporting the rice. The domestic retailers are the last in the internal trade of rice. They basically buy the rice from the wholesalers and sell it to the population.

Internally, there are two main sources of price volatility other than risks due to openness: inflation and seasonality. Sound macroeconomic policies reduce inflation in the 1990s and then the variability of the prices. Over the period of 1989- 1996, the real price of paddy and rice decreased, by 4.3 percent and 3.2 percent respectively. If this trend satisfied the rice's consumer, the story may be different for the rice's producers. The export quota is one factor that prevented the domestic price from fully adjusting to the international price by the imposition an implicit tax. On the aggregate level, seasonality price volatility is low (10 percent), while at the

district level, it may reach 30 percent.

In Vietnam, restrictions on internal trade of rice were implicit and took the form of heavy administrative procedures. In 1995, the rice's price difference between the north and the south was Dong 709 (US cent 6) per kilogram, of which only 42 percent can be explain by the transportation cost.[82] However, the restriction concerning the rice export is more explicit. The official argument is to ensure adequate domestic supplies and reduce price volatility. The government controlled the rice export through the use of a quota[83]. Roughly, between 1990 and 1995, these quotas were equivalent to an export tax around 25 percent.[84] The quota for rice has been lifted, but export licence, were still required and export taxes on rice were only 1 percent.

By the mid 1990s, the government removed most of the quota and production and exports increase. From being a net importer of rice, Vietnam turns itself into the second world largest rice exporter. Table A.3 displays the rice production, area cultivated, yield, rice's export and import between 1976 and 2000. Over this period, the country almost multiplies its rice's production by three (11.4 millions

[82] The rice price was D2,917 (US cent 26) per kilogram in the north and D2,208 (US cent 20) per kilogram in the south. The cost of transport of rice was estimated at D300 (US cent 3) per kilogram (IFPRI, 1996)

[83] The quota is binding if the internal or domestic price is below the border price and has a similar effect as an export tax.

[84] Vietnam exports primarily indica rice, mainly of intermediate and low quality. As documented in Nielsen (2002), Vietnam typically sells its intermediate and low-quality indica rice at a significant discount price relative to Thai counterparts.

tons in 1976 to 32.5 millions tons in 2000). This spectacular increase in rice production was due mainly to the increase of the rice yield, which double during this period from 2.1 tons/ha in 1979 to 4.25 tons/ha in 2000. Cultivated areas, at a lower level, explained also the increase of rice's production. In terms of international rice trade, Vietnam moved from being a net importer of rice, with an import of 0.14 million tons in 1984, to being the second world largest exporter, with a rice's export of 3.5 millions tons in 2000. Since the rice's production is done in rural area, which account for about 80 percent of the population, the country experiences a reduction of its poverty for more than half.

Table A.1: Vietnam, Selected Economic Indicators, 1991-2000

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
					(Annual growth %)					
GDP	6	9	8	9	10	9	8	6	5	7
Agriculture, value added	2	7	3	3	5	4	4	4	5	5
Industry, value added	8	13	13	13	14	14	13	8	8	10
Services, etc., value added	8	7	9	10	10	9	7	5	2	5
Exports of goods and services	30	25	9	52	25	56	0	4	23	25
Imports of goods and services	-6	19	42	61	40	44	23	3	1	34
Inflation, consumer prices (%)	83	38	8	9	17	6	3	7	4	-2
Official exchange rate (VND/US$)	10037	11202	10641	10966	11038	11033	11683	13268	13943	14168
					(% of GDP)					
Agriculture, value added	40	34	30	27	27	28	26	26	25	25
Industry, value added	24	27	29	29	29	30	32	32	34	37
Manufacturing, value added	13	15	15	15	15	15	16	17	18	19
Services, etc., value added	36	39	41	44	44	43	42	42	40	39
Trade	67	74	66	77	75	93	94	97	103	113
Exports of goods and services	31	35	29	34	33	41	43	45	50	55
Imports of goods and services	36	39	37	43	42	52	51	52	53	57
GDP (bill cst 2000 US$)	15.9	17.3	18.7	20.3	22.3	24.4	26.3	27.9	29.2	31.2
GDP per capita (cst 2000 US$)	235	251	266	284	305	328	349	364	377	397
GNI per capita, (curr US$)	110	130	170	200	250	300	340	350	360	380

Source: World Bank, 2004

Table A.2: Vietnam, Rice Production Performance 1966-2000

	Growth (%)		
	Cultivated area	Yield per Ha	Total Production
1966-75	1.59	2.22	3.80
1976-80	1.02	-0.55	0.46
1981-1987	-0.09	3.23	3.14
1988-1996	2.39	2.80	5.19
1997-2000	2.19	3.12	5.97

Source: Agricultural Statistic, General Statistic Office, Hanoi (2000) from Hai (2002)

Notes: Cultivated area: total area that yield 2 or 3 rice crops a year and total rice production=total cultivated area*average rice yield

Table A. 3: Vietnam, Rice production and characteristics, 1976-2000

Year	Total production (1,000tons)	Rice cultivated area (1) (1,000ha)	Rice yield (2) (Kg/ha)	Population (Mil.)	Per capita production (Kg)	Rice import (1,000tons)	Rice export (1,000tons)
1976	11,827	5,297	2,233	49.2	241	148	0
1977	10,597	5,469	1,938	50.4	210	196	0
1978	9,790	5,463	1,792	51.4	190	285	0
1979	11,363	5,485	2,072	52.5	217	320	0
1980	11,647	5,600	2,080	53.7	217	210	33
1981	12,415	5,652	2,197	55	226	12	0
1982	14,390	5,711	2,520	56.2	256	197	0
1983	14,743	5,611	2,628	57.4	257	42	0
1984	15,506	5,675	2,732	58.7	264	140	0
1985	15,875	5,704	2,783	59.9	265	336	59
1986	16,003	5,689	2,813	61.1	262	482	125
1987	15,103	5,589	2,702	62.4	242	323	120
1988	17,000	5,726	2,969	63.7	267	465	91
1989	18,996	5,896	3,222	64.7	295	55	1,372
1990	19,225	6,028	3,189	66.2	290	20	1,478
1991	19,622	6,301	3,114	67.6	289	6	1,061
1992	21,590	6,423	3,361	69.3	312	0	1,953
1993	22,836	6,559	3,482	71	321	0	1,649
1994	23,528	6,598	3,566	72.5	324	0	1,962
1995	24,926	6,766	3,684	73.9	337	0	2,025
1996	26,397	7,021	3,760	75.2	351	0	3,047
1997	27,524	7,100	3,880	76.7	359	0	3,682
1998	29,142	7,362	3,990	78.1	373	0	3,793
1999	31,390	7,465	4,205	79.5	395	0	4,550
2000	32,554	7,655	4,253	80.9	402	0	3,500

Source: General Statistic Office, Hanoi, 2001

Note. (1) Cultivated area: total area that yielded two or three rice crops per year (2) Yield: average rice yield per hectare of cultivated area.

8 Appendix B: Presentation of the 1992/93 and 1997/98 Surveys Design

Overview: Vietnam[85] implemented its first Vietnam Living Standards Survey (VLSS) in 1992-93 and a second one in 1997-98. Both VLSS surveys were funded by UNDP and Swedish International Development Authority (SIDA). The survey was part of the Living Standards Measurement Study (LSMS) household surveys conducted in a number of developing countries with technical assistance from the World Bank.

The second VLSS was designed to provide an up-to-date source of data on households to be used in policy design, monitoring of living standards and evaluation of policies and programs. The timing of the second VLSS approximately five years after the first allows analysis of medium term trends in living standards as a large part of the questionnaire is the same in both surveys.

Sample size: The target sample size selected for the 1997-98 Vietnam Living Standards Household Survey (VLSSII) was 6000 households. The majority of the sample was comprised of the households interviewed from the 150 communes selected in 1992-93 with the first VLSS survey (4800 households). Households are defined as

[85] This appendix draws heavily from World Bank (1994, 2001).

people living and eating meals together in the same dwelling. In most cases there is only one household per dwelling as people who live together usually eat together. There were no clear indications in the various manuals on what to do if more than one household lived within one dwelling.

The sample in 1992-93 was a self-weighted sample drawn from all areas of Vietnam, which means that each household in Viet Nam had the same probability of being selected. The weight or expansion factor for each unit is then 1. The overall sampling frame was stratified into two groups urban and rural, with sampling carried out separately in each group (strata). According to the 1989 census, about 20% of Vietnamese households lived in urban areas so the sample stratification ensured that 20% of selected households also came from urban areas. Within each of the two strata, a list of communes was drawn up province by province from east to west and north to south. The selection of communes within each list was done to ensure that they were spread out evenly among all provinces in Vietnam.

Primary Sampling Unit (PSU): Within each province in Vietnam, rural areas can be broken down into districts, districts broken down into communes and communes broken down into villages or hamlets. Urban areas consist of cities, provincial and small towns. Small towns are usually small areas and are divided into wards, and wards

divided into blocks. Large cities and provincial towns are usually divided into districts, then wards and finally blocks. There were approximately 10,000 possible PSUs in 1992-93 (and 10,331 in 1998.) The average population in each PSU was approximately 6,500.

Sampling stages: The VLSS sample was drawn in three stages with communes/wards and small towns chosen as the primary sampling unit as that was the lowest administrative unit for which the estimates of population in 1992 was available. A total of 150 communes/wards were selected systematically out of the 10,000 in all of Vietnam with probability of selection proportional to their population size. As some communes are quite large in size, logistically it would have been difficult to interview 32 households selected randomly within each commune/ward. Instead, population figures for each village/block were compiled from the selected communes to select two villages/blocks randomly with probability proportional to their population size. Finally, the third stage involved listing all households within each selected village/block and selecting 20 households (16 for the sample and 4 extras if it became necessary to replace a selected household). As there were two stages of sampling for which the sampling unit could be called a cluster, the term commune/ward and village/block are used instead of cluster to designate the different units.

For the sample to reach 6000 households in 1998, an additional 1200 households were required. This was done by selecting households from the total sample of the 1995 Multi-Purpose Household Survey (MPHS) of the General Statistical Office (GSO). In order to provide an adequate sample to disaggregate results into the seven major regions for rural areas and three categories of urban domains, the selection of the additional households was not proportional to population, but instead was chosen so that the total sample of 6000 households over-sampled specific domains. It is essential in doing analysis to utilize the sample weights in the data to avoid biases in results due to over sampling of urban areas, and certain regions of the country.

Again, for survey implementation reasons, the households are not randomly selected throughout each domain, but are selected in groups of two villages/blocks in a commune/ward, and 16 households per village/block (15 households for the MPHS part of the sample). The final sample is therefore made up of 4704 households from the VLSS 1992-93 communes, and 1290 households from the MPHS survey communes for a total of 5994 households.

The household listings used for sample selection were provided by the local authorities, and in most cases consisted only of long-term registered households. As migration has increased in recent years, especially in urban areas and the Central Highlands, this could lead

to some biases in the results as temporarily registered households would not have had a chance of being selected.

Weights or Expansion Factors[86]**:** Notice that the 1992/93 survey has been self-weigthed, which means that the weight for each observation unit is 1. In order to make estimates relating to groups of domains, or to the whole sample for the 1997/98 survey, the data must be weighted in order to correct the bias due to deliberate over- or under-sampling. This manipulation increases the sampling error slightly for nationwide estimates but allows one to do more precise analysis within each domain. The formula for calculating the weights (or expansion factors) consists of the following factors to deal with the probability of the household being sampled at the different stages of sampling: (i) the probability of being in the VLSS or MPHS part of the sample; (ii) the probability of the commune/ward being selected out of the domain (strata) (iii) the probability of each of the two villages/blocks being selected out of the whole Commune / ward; (iv) the probability of 16 (15 for MPHS) households being sampled out of the village/block; (v) a factor to adjust for changes in number of households in the village/block between the original sample selection year and the time of the survey in 1997-98.

[86] **For a more detailed description of the sample design for VLSS 1997-98 see World Bank (2001).**

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EDUCATION:

Ph.D., Economics, University of Maryland at College Park, USA, 2006.
M.A., Economics, University of Maryland at College Park, USA, 2002.
M.A., Economics and Statistics, School of Statistics and Applied Economics, Côte d'Ivoire, 1996.
M.S., Applied Mathematics, University of Abidjan, Côte d'Ivoire, 1993.

FIELDS OF SPECIALIZATION: International trade, Econometrics.

EXPERIENCE:

Senior Economist, IDEA International, Quebec, Canada, 2006-Present;
- Monitoring and evaluation of Poverty Reduction Strategies and MDGs;
- Household socio-economic surveys and studies;

Economist-Consultant, World Bank, Washington, DC – USA, 2000- 2006 [1].
- Conducting poverty analysis and preparing poverty assessments for West and Central African Countries; Impact of commodity market liberalization on farmers.
- Prepared chapters on poverty and trade for the Regional PRSP of the West Africa Region; (Regional Integration Coordination, AFRCE).
- Prepared analytical work on the impact of agriculture subsidies on developing countries for the Global Economic Prospects 2004 report, (DECPG).
- Contributed to the World Bank Regional Integration Assistance Strategy (RIAS) for West Africa report, 2000-2003 (AFTM4).
- Conducted Economic Sectoral Work (ESW) for Côte d'Ivoire – (AFTM4).

Consultant, Bernan Associates, Lanham, Maryland – USA, 2001 – 2004.
- Produced a database for the USA economy: "Datapedia of the United States: America Year by Year, 1790 – 2005".

Economist, World Bank, Abidjan, Côte d'Ivoire, 1997-2000.
- Provided technical assistance to the government on public expenditure issues.
- Conducted Economic Sectoral Review (PER, CAS, cocoa-coffee reforms,).

Economist, Ministry of Planning, Abidjan, Côte d'Ivoire, 1996-1997.
- Prepared a country macroeconomic framework from 2000 to 2005 ("Elephant d'Afrique #2", Côte d'Ivoire government internal document).
- team leader for the preparation of the macroeconomic review of the Ivorian economy 1996-1997.

[1] I quit my position as an economist in the World Bank Abidjan office in order to pursuit my PhD in Maryland. I am working part time as a consultant while in school.

Lecturer, University of Maryland at College Park, USA, 2003 and 2004
Teaching Economics of Developing Countries (Econ315)
(Course website: http://www.wam.umd.edu/~ggohou/Econ315.htm)

EXPERIENCE: (continued)

Lecturer, ENSEA[2] and INSTEC[3] Abidjan, Côte d'Ivoire, 1996-1999
Taught Factor Analysis Methods, and microeconomic theory.

Statistician, Power Plant Company (Compagnie Ivoirienne D'electricite) – CIE, 1995
Developed database to forecast the electricity demand.

COMPUTING & QUANTITATIVE SKILLS:

Microsoft office package (Word, Excel, PowerPoint, Access)

Programming languages and database: Mathematica, Matlab, GAMS, Visual Basic, Access.

Statistics and Econometrics software: STATA, SAS, Microfit, RATS, TSP, SpadN, Eviews, Epi-Info.

LANGUAGES:

French: native; English: fluent; Spanish: fair.

HONOR, AWARD, VOLUNTEER SERVICE AND OTHERS:

Volunteer at the Center of Young Children at the University of Maryland (2002).

Volunteer for tutoring for Econ. and Econometrics at University of Maryland 2001/02.

Graduate Assistantship of University of Maryland, USA, since spring 2001.

World Bank's Spot Award - 12/2000.

Fellowship of the Ivorian Government (2000 – 2004).

Fellowship of the European Development Fund (1993 - 1996).

SELECTED PUBLICATIONS AND PROFESSIONAL REPORTS:

"Do Cotton Prices Follow Polyester Prices?" (with J. Baffes), 2006, in "Agricultural Commodity Markets and Trade, New Approached to Analyzing Market Structure and Instability" Edited by A. Sarris and D. Hallam, FAO pp233-255.

"Price Liberalization and Poverty Among Coffee Producers in Burundi" (with Q. Wodon), February 2005, World Bank mimeo, presented during the World Bank, Africa Region Poverty Unit Seminar, March 11, 2005

"Tea Sector Reforms And Poverty In Rwanda", (with Q. Wodon), February 2005, World Bank mimeo

"Self-Rated Perception of Welfare, Ethnic conflict and Poverty: Evidence from Burundi" (with Q. Wodon), February 2005, World Bank mimeo

"Côte d'Ivoire: Public Expenditure Review 2000-2001", (with Z. Bogetic, R. Doffonsou) December 2004 – The World Bank, publication

"Accelerating Regional Integration in West Africa." (with C. N'Cho, De Azcarate; C. Humphrey; F. Charlier, F.; Marie Nelly, MF) - The World Bank 2001 – Discussion Paper.

"Côte d'Ivoire: Public Expenditure Review 1991-1998.", vol 1 & 2. (with J. McIntire) – The World Bank, October 1999.

REFERENCES: (Available upon Request)

[2] ENSEA stands for École Nationale Supérieure de Statistiques et d'Économie Appliquée.
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