Rice Market Integration in the Mekong River Delta
The successful liberalisation of the domestic food market in Vietnam

Luu Thanh Duc Hai, Clemens Lutz and Cornelis Praagman [#]

SOM theme B Innovation and Interaction

Abstract

This article analyses the spatial price differences in the rice market of the Mekong River Delta to assess the impact of the liberalisation policies on its functioning. The results of these policies carried out during the last two decades are impressive. The rice market system in the Delta is competitive. Price patterns strongly cohere and are integrated with the regulated export prices. However, price patterns in other regions and in particular in the North, are only weakly integrated with price patterns in the South. Private traders in the South satisfy local demand and deal with State Owned Enterprises (SOEs) involved in exports and transactions with the North. In the framework of the national food security policy, the state owned food companies subsidise transactions between the South and the North. Therefore, no profitable long distance trade can be established. Moreover, the state owned food companies acquire nearly all licences to export (quota). We conclude that, despite all the dramatic changes, the liberalisation process still faces major challenges.

(also downloadable) in electronic version: http://som.rug.nl/

Luu Thanh Duc Hai is lecturer at the School of Economics and Business Administration, University of Cantho, Vietnam.

Cornelis Praagman is associate professor at the Faculty of Economics of the University of Groningen, the Netherlands.

Clemens Lutz is associate professor at the Faculty of Management and Organization, University of Groningen, the Netherlands.

1. Introduction.

During the last decades the organisation of the Vietnamese rice market experienced some dramatic changes. In 1975, after the devastating war and the reunification of the North and the South, several attempts were made to introduce a collectivised agricultural production system in the South of Vietnam. In line with these policies, wholesale private trade was prohibited and marketing parastatals controlled the rice market. By 1980, Vietnam was facing large food deficits as a result of declining productivity. In that year it produced only 73% of its food requirements (UNDP, 1989). Already in 1981 the agricultural policy switched to a more flexible contract system. However, more dramatic changes were needed to improve the situation. During the last 20 years a series of reforms were established to liberalise the domestic rice markets. The reforms in the agricultural sector were part of the 'Doi Moi' (new way) economic policy. See Irving (1995) for a discussion of the impact of these changes on the Vietnamese economy.

The institutional changes triggered rapid growth in the rice sector (Minot and Goletti, 2000). At present Vietnam is a major rice exporter in the world market and in particular the surplus produced in the Mekong River Delta is sold abroad. Between 1996 and 1999 on average 3 million tons of rice, about 40% of total rice production in this region, were exported from the Mekong River Delta (VFA, 2000). Although rice exports are still controlled by parastatals (Khiem et al., 1995; Pingali et al, 1997; VFA, 2001; Pohl-Nielsen, 2002), the transactions in the domestic rice market are completely liberalised and private retailers, wholesalers and millers handle a major part of the domestic marketable surplus. Large numbers of small-scale retailers and wholesalers are active in the market, while a smaller group of private millers/wholesalers accumulated enough capital to deal with large-scale transactions. The domestic rice market structure in the Mekong River Delta is characterised by competition: no important entry barriers were observed, the degree of trader concentration is low, rice products are marketed in a rather homogenous form and market information is relatively easy to obtain (Luu T. Duc Hai, 2003). These factors indicate that the liberalisation policy has been successful and facilitated the development of a competitive and integrated market. However, Minot and Goletti (2000, p. xiii) observed that the degree of market integration remained weak. This raises the question how integrated the market really is? To date no comprehensive studies of the market integration process in the domestic rice-market of Vietnam are published. The importance of this staple food market for the population and the short time lapse in which the dramatic changes in the organisation of this market took place, further underline the relevance of this question.

In integrated markets an arbitrage process operates that limits price differences in time, form and space, to the marketing costs. Spatial price behaviour in regional rice markets is an important indicator of overall market performance. Markets that are not integrated may convey inaccurate price information, distorting the marketing decisions of rice producers and contributing to inefficient product movements (Tomek and Robinson, 1990). Sexton et al. (1991) identified three reasons for a lack of market integration: prohibitive transaction costs, different kinds of trading barriers and imperfect competition. Since the seminal paper of Harriss (1979) a large body of literature, dealing with this topic, is published. Different methods were developed to analyse spatial price-differences and to test for market integration (Ravallion, 1986; Alexander and Wyeth, 1994; Kuiper et al., 1999).

Baulch (1997) criticises the conventional tests for market integration as transfer costs and non-linearities implied by the spatial arbitrage conditions, were neglected in these models. Subsequently, Abdulai (2000) showed that threshold cointegration tests could be used to accommodate this problem.

This article focuses on spatial price-differences in the rice market in Vietnam. Taking into account the characteristics of the market under study, an empirical test is developed to verify whether price patterns in different locations cohere. Price adjustment processes in the long and short-run are distinguished. Two specific research questions are dealt with. First we want to examine whether the degree of integration between the markets in the South and some markets at a larger distance (Central Highlands, the North and the regulated Export Rice Price) differs? The relevance of this question results from an observation made by Goletti and Minot (2000, p. 34) that price differences between the South and the North were larger than would be expected on the basis of marketing costs. The second question verifies whether evidence can be found in the price series for the expectation that the regulated export price (the so-called 'guidance export price'[1]) dominates the domestic price formation process. As most of the marketable surplus in the Mekong River Delta is exported, this appears to be a likely hypothesis.

The article is structured as follows. In the next Section a short overview is given of the reforms that were carried out in the last two decades. This Section will shed some light on the dramatic changes that have taken place in the organisation of the rice market. A good understanding of these changes serves as a necessary background for the interpretation of the results. The third Section shows the price series in 1998-2001 and focuses on the spatial price differences observed. Subsequently the method is presented to test for market integration. In section 5 the results are discussed and finally conclusions are drawn.

2. A chronological overview of major reforms in the agricultural sector in Vietnam

The period after 1975

By 1975, the year of unification with the South, nearly all northern rural households were members of agricultural producers' co-operatives, cultivating 95 percent of the arable land and producing 92 percent of total agricultural output. The government started the mobilisation campaign for the "organisation of agricultural production towards socialist large-scale production" (Pingali and Xuan, 1992). Many co-operatives merged, thereby reducing the total number from over 40,000 co-operatives to less than 20,000 co-operatives. However, in particular in the South, they did not meet expectations. In Southern Vietnam production activities continued on a family farm basis and collective effort was made only for obtaining inputs and marketing output. In general the failure of collectivisation can be attributed to policies that disregarded producer incentives and disrupted market mechanisms for the flow of inputs and outputs (Pingali and Xuan, 1992). The upshot was diseconomies, instead of

[1] The Vietnamese government controls rice exports explicitly through a quota system and implicitly through the fixing of a minimum export price. The Vietnamese Food Association sets these floor prices and rice exporters are expected not to accept export contracts below this minimum (Pohl-Nielsen 2002).

economies, of scale. In this period, local trade (retail) was allowed, while inter-regional trade (wholesale) was monopolised by parastatals. The former private milling sector in the Mekong River Delta was nationalised and replaced by state owned enterprises. Only some small-scale millers were tolerated, but they operated under difficult circumstances.

The 'contract system' – 1981

In response to the disappointing results of the collectivisation policy, the contract system of production was designed to improve producer incentives and, thereby, increase productivity. In this system, individual households enter into a contract with the collective to produce a certain level of output on their land. The contracted output had to be sold to the state for a fixed price. All output beyond the contracted amount could be kept for home consumption or sold to private retailers. The organisation of the rice market did not change in this period. Milling and wholesaling activities (inter-regional transfers) were completely controlled by state owned companies.

Land allocation and privatisation of output markets -1988

A major reform took place by the promulgation of resolution number 10 in 1988 in the framework of the '*Doi Moi*' policy. It assigned land to individual households for 10-15-20 year's on the basis of a renewable lease. This improved the land rights of households and implied that farmers could not be displaced without consent and a fair compensation for the cost of land development. Farmers were also free to decide what to produce, how to produce and how to market their farm products. The role of the co-operatives changed and was focused on the provision of services like irrigation management, technical know-how transfer etc. Production teams were replaced by peasant households as basic units of agricultural production. Farmers were no longer required to sell a quota to the State. Instead of this, a commission had to be paid to the board of the collectives to pay for the delivered services, and taxes were levied on the basis of the assessed value of their land. Private traders were given equal rights to purchase rice from the farmers.

Rice market liberalisation after 1989

A number of changes were implemented in the framework of the liberalisation policy. The year 1989 is a landmark as some important initiatives were made:
Private rice traders were allowed to deliver paddy/rice out of the province. The checkpoints at the border of the provinces were abolished.
The milling facilities, nationalised a decade before, were returned to the private owners who were allowed to re-enter the milling business.
The Vietnamese Food Association (VFA) was established in 1989 in order to help and support both state and private rice traders.

Remarkably, only since 1996 private traders were allowed to become member of the VFA. The association facilitates the following activities: the search for new export markets, the provision of relevant market information, collaboration with Thailand to control the quality of rice and to stabilise export prices (VFA, 2001). Their most important task was to distribute the export quota among their members. During the last years, the VFA allocated more than 96 percent of the total rice export quota of the country. Until 2000 all the licences were given to state owned food companies. In that year the first private traders became member of the association and obtained an export licence: 39 state owned food companies and 8 private traders. In order to be eligible for an export licence (quota) the following conditions are to be fulfilled: availability of a license for rice trading, good facilities and capital for processing and storing (at least 500 tons) and a good reputation. Formally the most important barrier for private traders, to obtain an export licence, concerns the minimum quantity. However, in particular in the beginning, most private traders were too hesitant to enter this business and simply did not apply for a licence or membership. The future has to make clear to what extent the interests of the private traders are indeed supported by the association.

In the course of time additional changes were made. In September 2000, the government decided to eliminate the inter-regional transaction tax for rice traders[2]. This policy encouraged rice traders to enlarge the scale of their business and to become more involved in inter-regional arbitrage. Also the administrative requirements for entry into rice trading (business license) have become easier to fulfil. At present only one registration form is required, needing approval of only one provincial office. In Ho Chi Minh (HCM) City, the businessmen can even apply for their license by internet[3]. In 2000, the Department of Trade Promotion (Viet-trade) was established in the Ministry of Trade. Among others, the mandate of Viet-trade is to create good relationships with foreign companies and to obtain suitable information about international markets and other consultancy services for the rice business.

3. The results: what do spatial price differences look like in the period 1998-2001?

The last Section briefly reviewed the dramatic policy changes. This raises the question how operational the present market system is? How do prices in local markets adjust? Are these markets integrated? Minot and Goletti (2000) analysed monthly wholesale prices and concluded that the degree of market integration is deficient. However, a serious drawback of their study is that the analysis is not based on day-prices or average week-prices. Average month-prices are only rough estimates of day-prices, especially during periods of changing market conditions. Moreover, average month-prices are not the right variables to measure the short-run price integration process. In Vietnam, day-prices are available for only a few market places and only for a short period of time. Therefore, we use weekly price series, from 1998 to August 2001. The analysis is based on retail price series of 25 percent broken rice, the most popular quality in the domestic market. Nine major market places are chosen: four retail markets are located in the Mekong River Delta (Angiang, Cantho, Soctrang, and Tiengiang), two retail markets are located in the middle and central highlands area (Lamdong, and Danang), and two urban retail markets (HCM City and Hanoi). Finally, the regulated export market

[2] The transaction tax was levied if products were transferred to other provinces.
[3] Web-site: www.HCMSTE.Gov.VN

price (VN)[4] is included in this analysis. This outlet drains the domestic surplus and concerns wholesale transactions. The weekly price data were provided by the Cantho Trade Department, Information Centre of the Ministry of Agriculture and Rural Development, and the Ministry of Trade of Vietnam.

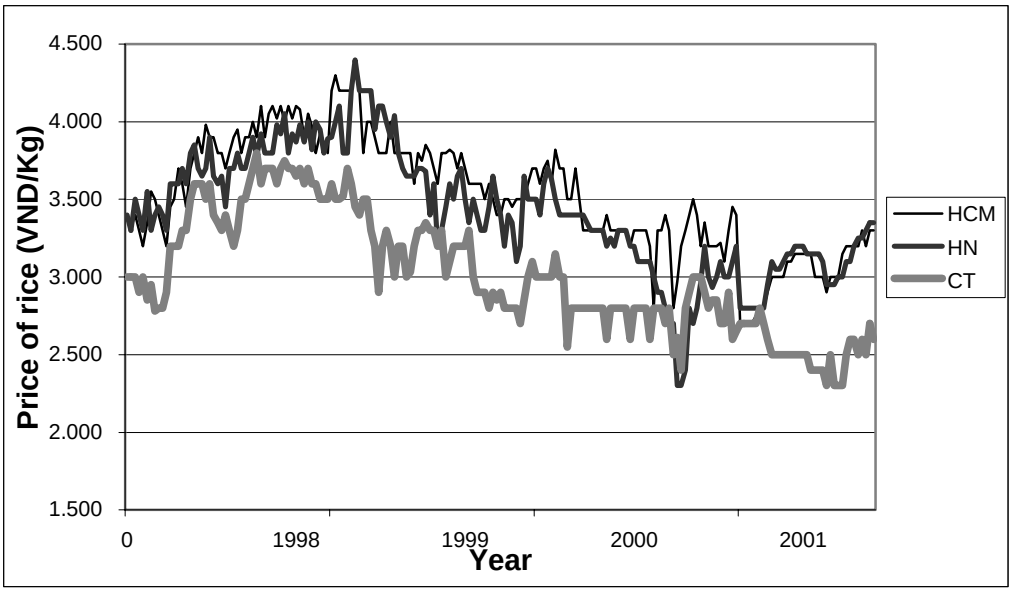

Figure 1: *Rice price series of HCM City, Hanoi, and Cantho 1998 - 2001*

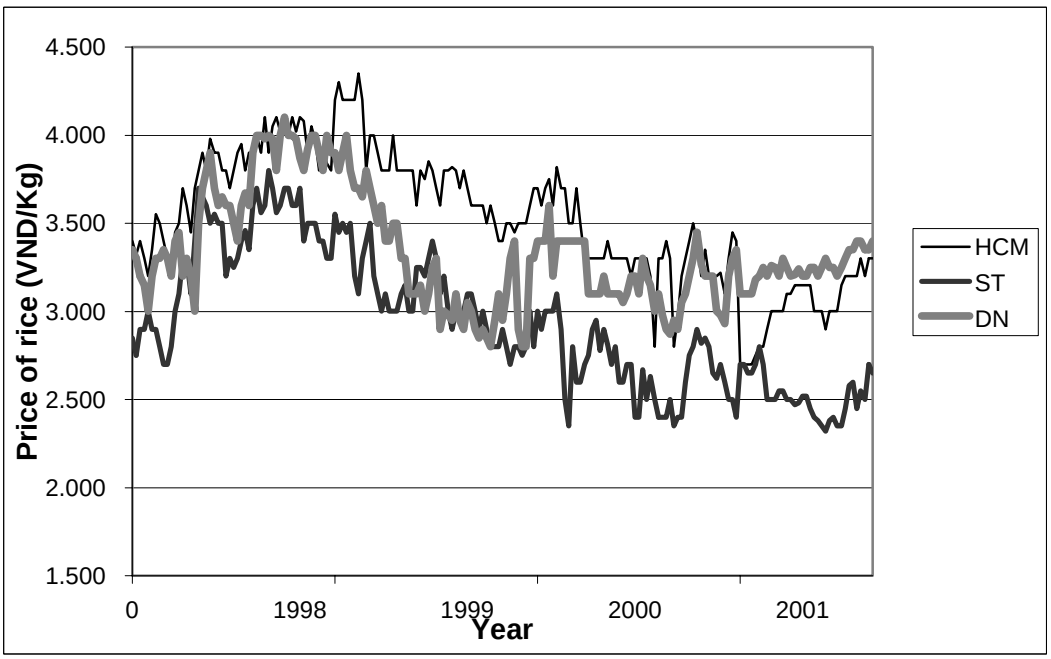

Figure 2: *Rice price series of HCM City, Danang, and Soctrang 1998 – 2001*

[4] The series of the VN export prices for 25% broken rice are collected from the Trade Department of Cantho (Source: Vitranet). The price series in US dollar are converted into Vietnamese dong by using a monthly average exchange rate (Luu T. Duc Hai, 2003)

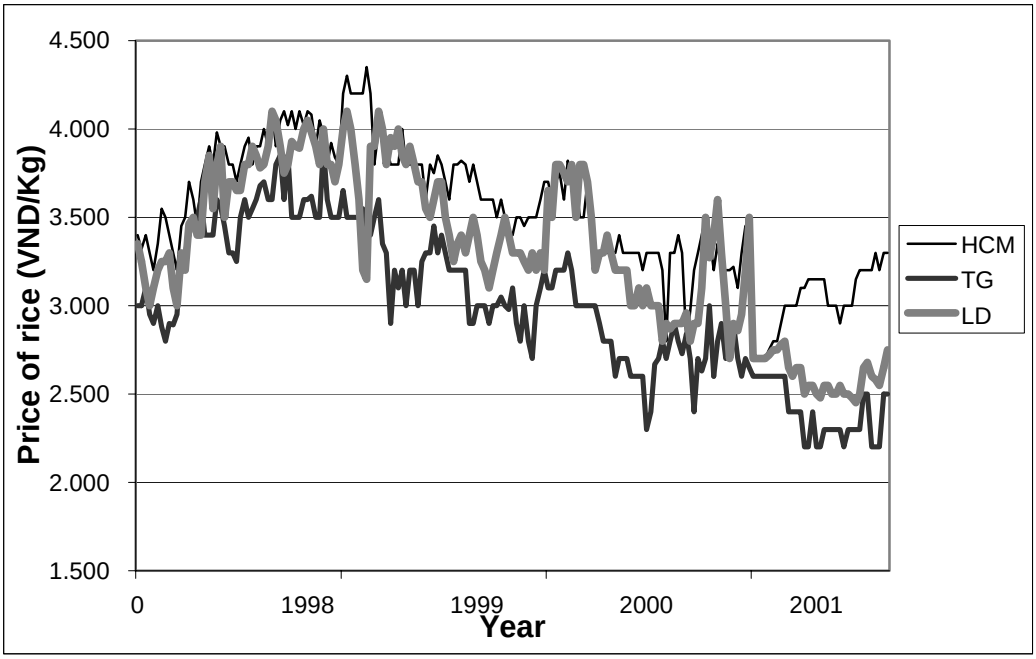

Figure 3: *Rice price series of HCM City, Tiengiang, and Lamdong 1998 - 2001*

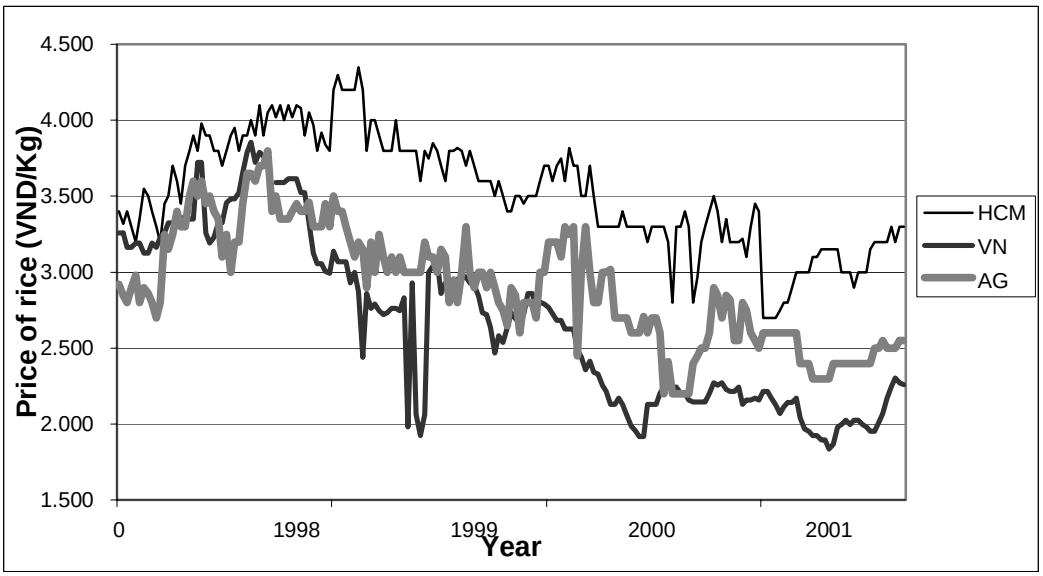

Figure 4: *Rice price series of HCM City, Vietnam export price, Cantho 1998-2001*

The figures show the price series for nearly 4 years. Prices were not disrupted by major inflation rates[5] and seem to follow the same price pattern. Price levels in the production centres in the delta are well below retail prices in HCM City. Also prices in Hanoi are generally inferior to prices in HCM. Taking into account that 20% of supply in the North is 'imported' from the Mekong River Delta and that

[5] Inflation rates were very low during the period under study. Inflation rates were 5.2%, 5.2%, 5.1% and 5.3% respectively for 1998, 1999, 2000, and 2001 (www.vitranet.com.vn). Therefore we were able to use nominal prices for this analysis.

transport costs to Hanoi are higher than transport costs to HCM, this is remarkable. In order to get a clear picture of what is happening a further analysis of the price differences and marketing costs between market places is needed.

Table 1 shows that price differences between the markets in the Mekong River Delta are relatively low. Domestic trade with HCM City gives the highest average margin. Price differences between the Mekong River Delta and the markets in the Central Highlands of Vietnam (Lamdong) and the North (Hanoi) are less attractive for private traders. The Table also shows a large number of negative price

Table 1: Price differences between the formal market places under study

Surplus Market	HCM City (HCM)	Hanoi (HN)	Lamdong (LD)	Danang (DN)	Vietnam exp(VN)	Cantho (CT)	Angiang (AG)	Soctrang (ST)	Tiengiang (TG)
1. Cantho									
Number of observations [1]	191	191	191	191	191		191	191	191
Average price differences [2]	511	429	315	366	399		163	100	121
Coefficient of variation [3]	0.39	0.54	0.75	0.65	0.60		0.86	1.03	0.87
Minimum price difference	0	-400	-400	-500	-1274.9		-600	-500	-500
Maximum price difference	950	1200	1250	1000	392		500	210	450
Negative price difference [4]	0.0%	4.7%	6.3%	11.0%	84.3%		65.4%	58.1%	40.3%
2. Angiang									
Number of observations	191	191	191	191	191	191		191	191
Average price differences	615	524	406	450	336	163		123	164
Coefficient of variation	0.37	0.48	0.60	0.59	0.66	0.86		0.89	0.90
Minimum price difference	100	-200	-50	-350	-1135.4	-500		-650	-400
Maximum price difference	1250	1300	1050	1000	484.6	600		500	700
Negative price difference	0.0%	2.6%	0.5%	7.3%	72.8%	21.5%		33.0%	27.2%
3. Soctrang									
Number of observations	191	191	191	191	191	191	191		191
Average price differences	585	492	377	428	345	100	123		58
Coefficient of variation	0.38	0.50	0.69	0.58	0.66	1.03	0.89		2.03
Minimum price difference	0	-200	-50	-400	-1324.9	-210	-500		-350
Maximum price difference	1250	1300	1450	1050	508.5	500	650		650
Negative price difference	0.0%	2.6%	2.6%	9.9%	80.1%	16.8%	51.3%		33.0%
4. Tiengiang									
Number of observations	191	191	191	191	191	191	191	191	
Average price differences	528	442	330	395	377	121	164	149	
Coefficient of variation	0.42	0.58	0.63	0.72	0.64	0.87	0.90	0.79	
Minimum price difference	-50	-400	-350	-600	-1374.9	-450	-700	-650	
Maximum price difference	1100	1200	1050	1200	325.5	500	400	350	
Negative price difference	1.0%	4.2%	3.7%	12.6%	82.2%	36.1%	56.5%	53.9%	

Note: [1] Number of pairs of prices observed (25% broken rice, period 1998-2001)
[2] Based on absolute differences
[3] The coefficient is calculated as follows: $\sqrt{(\sum (x_i - \bar{x})^2)/(n-1)}$
[4] The percentage expresses the number of observations with a negative price.

Source: Cantho Trade Department, Information Centre of the Ministry of Agriculture and Rural Development, and the Ministry of Trade of Vietnam.

differences between the retail markets in the delta and the export market. This seems to indicate an inconsistency in the data. We recall that the regulated export prices (VN) concern wholesale bulky transactions. The retail margin explains why the wholesale export price level is generally below the retail price levels in the Mekong River Delta.

We note that the coefficient of variation for price differences in absolute values is quite high. Positive price differences regularly become negative. Only HCM seems to be a relatively save target market: negative price differences were not observed and the coefficient of variation is relatively low.

The estimated direct marketing costs are presented in Table 2. The costs are calculated on the basis of data collected in the Mekong River Delta (Luu T. Duc Hai, 2003). Major determinants for the costs are distance (transport) and the organisation of the marketing channel (use of intermediaries). The cost structure is given for the most general marketing channel through which rice is traded between the indicated markets. In the annex a detailed calculation is given. The costs are low for transactions within the delta and relatively high for shipments to HCM. Most costly are transactions with Hanoi.

The percentage (Table 2) expresses the number of times the absolute price difference is larger than the calculated marketing costs. We note that only costs are involved in the margin (no mark-up for profits). The results show that transactions between the rural markets in the Mekong River Delta are not attractive. Only timely transactions with Tiengiang, the commercial centre for rice in the delta, are interesting if proper information on price differences is available. This is in line with what is observed in the delta. The rural markets are supplied directly by assemblers coming from the villages. Intermediate trade flows between the markets are scarce (Luu T. Duc Hai, 2003).

Table 2: Estimated direct marketing costs for transactions between the markets under study (VND/Ton) and the number of times price differences exceed these estimations.

Market	HCM City	Hanoi	Lamdong	Danang	Cantho	Angiang	Soctrang	Tiengiang
Cantho	419,000 69%	661,000 15%	374,000 36%	509,000 25%		161,500 6%	161,500 8%	175,000 15%
Angiang	466,000 76%	675,000 18%	388,000 44%	523,000 35%	161,500 6%		169,000 5%	189,000 13%
Soctrang	445,000 76%	675,000 14%	388,000 38%	523,000 28%	161,500 8%	169,000 5%		189,000 10%
Tiengiang	355,000 77%	601,000 25%	314,000 46%	449,000 33%	175,000 15%	189,000 13%	189,000 10%	

Source: Derived from Appendix 1, 2, and 3

HCM City is the most attractive destination. Price differences are normally superior to the direct marketing costs. HCM is the centre for the export business that drains 40% of rice production. Interestingly, private trade with Hanoi and the other markets outside the delta, are much less attractive. This explains why private traders are not interested to supply this market in deficit periods. State owned food companies are involved in these transfers. They are not driven by price differences but by administrative decisions made in the framework of the national food security policy and the buffer

stock program (Van Nguyen Trung, 1998). During our survey we did not meet any private trader in HCM City involved in transactions with the North. Only a few private traders transfer rice from Tiengiang to markets outside the delta: incidentally traders try to exploit temporary price differences, or are looking in the South for a return freight in order to regain at least part of the costs for the return trip of their truck.

We conclude that price differences are volatile. Profitable private trade is possible in particular from rural markets in the delta to HCM City. Inter-regional price differences are less attractive for private trade. This brings us to the question how the price series between these markets are linked. How do the price series between markets adjust?

4. Method

In an efficient market system prices move together: "trade takes place if price in the importing region equals price in the exporting region plus the unit transport cost incurred by moving between the two" (Ravallion, 1986). The result of efficient trade and arbitrage activities is that prices at different market places cohere. Cointegration analysis will allow us to verify this. The Johansen (1991) maximum likelihood estimators test for the presence of multiple co-integrating vectors. This can be interpreted as a test for long-run market integration. Moreover, it is possible to look for restricted versions of the co-integrating vectors and the speed of adjustment parameters. This allows us to draw conclusions about the short run adjustment process.

Mathematically, the starting point for a model for testing market integration based on multiple co-integrating vectors is the following:

$$x_t = A_1 x_{t-1} + A_2 x_{t-2} + \ldots + A_{p-1} x_{t-(p-1)} + A_p x_{t-p} + \varepsilon_t \quad (1)$$

Where:

t = 1, 2,….. refer to the weeks from 1998 to August 2001

n is the number of markets included in the analysis

p is an a priori unknown integer, its value has to be determined

x_t is an $n \times 1$ vector of variables $(x_{1,t}, \ldots, x_{n,t})'$: [price of n market places]

A_i is an $n \times n$ matrix of coefficients

ε_t is an $n \times 1$ vector of error terms

If we define $\Delta x_t = x_t - x_{t-1}$, then equation (1) can be put in a more suitable form by replacing x_{t-k} by $x_{t-k+1} - \Delta x_{t-k+1}$ for $k = p, \ldots, 2$:

$$\Delta x_t = \sum_{i=1}^{p-1} \Pi_i \Delta x_{t-i} + \Pi x_{t-1} + \varepsilon_t \quad (2)$$

Where: Π and Π_i are defined by

$$\Pi = \left(\sum_{i=1}^{p} A_i - I \right)$$

$$\Pi_i = -\sum_{j=i+1}^{p} A_j$$

Regressing Δx_t on $\Delta x_{t-1}, \ldots, \Delta x_{t-p-1}$ and x_{t-1} yields an estimate for Π. In this sense the Johansen test can be seen as a multivariate version of the Augmented Dickey-Fuller test for the existence of a unit root. If Π has full rank, then all the elements of x_t are stationary, if Π is zero, they all are integrated. In the intermediate case that Π has defective rank, its rank determines the number of independent cointegrating relations: linear combinations of the non-stationary elements of x_t, that are stationary.

Johansen defines two matrices α and β, both of dimension $n \times r$, where r is the rank of Π, such that: $\Pi = \alpha\beta'$

The matrix β is the matrix of co-integrating relations, and the matrix α is the matrix of weights with which each co-integrating vector enters the *n* equations of the vector error correction model (VECM). α can be viewed as the matrix of the speed of adjustment parameters as explained below. Due to the cross-equation restrictions and the fact that parameters enter the model in a non-linear way, it is not possible to estimate α and β using OLS. However, with maximum likelihood estimation, it is possible to (i) estimate (1) as an error-correction model; (ii) determine the rank r of Π*;* (iii) use the r most significant co-integrating vectors to form β; and (iv) select α such that $\Pi = \alpha\beta'$. The Johansen procedure estimates the rank of Π by an iterative process, comparing the null of rank at most r, with the alternative of rank larger than r.

The equation for a single element now takes the form

$$\Delta x_{i,t} = ... + \alpha_{ij} \sum_k \beta_{kj} x_{k,t} + \varepsilon_{i.t}$$

where for notational simplicity, we have not written out the coefficients of the $\Delta x_{j,t-k}$.The linear combinations $\sum \beta_{kj} x_{k,t}$ are the cointegrating relations that occur in every equation, the coefficients α_{ij} determine the weight that these coefficients have in the equation. Interpreting the cointegrating relation $\sum \beta_{kj} x_{k,t}$ as a long term equilibrium relation, the α_{ij} can be seen as the influence that the deviations from the long term equilibrium have on the changes in x_i: a large value for α_{ij} shows a strong dependence on the long-term equilibrium.

5. Results of the test

Step 1: Testing for stationarity

Looking at the plots of the data it is clear that none of the series is stationary. We start by pre-testing all variables to assess their order of integration by an Augmented Dickey Fuller (ADF) test on a unit root. Here we encounter a first problem: If we test for a unit root with intercept and trend we have to reject the null hypothesis in most cases. But in the final VAR that we would model none of the trends is significant. On the other hand if we test for a unit root with only an intercept all series have a unit root.

We decided to proceed with the second alternative. In none of the cases this leads to a non-invertibility problem that is to be expected in case of overdifferencing. Furthermore, as we will see in step 3, the Johansen integration test only indicates a view cointegrating relations, contradicting the assumption that all or most series are stationary.

So the test equation for the levels is:

$$\Delta x_t = \alpha + \delta x_{t-1} + \sum_{k=1}^{p} \gamma_k \Delta x_{t-k}$$

Using the ADF test, the results presented in Table 3 indicate that the price series for the nine markets under study are I(1). For all the price series the unit root test (with an intercept) shows that the coefficients of x_{t-1} are not significantly different from zero and so none of the price series is stationary. Furthermore, the unit root test on first differences (without an intercept) confirms the opposite, which leads us to conclude that all series are integrated of order 1. This result implies that taking first differences as variables in the model will eliminate the stochastic trend in the nominal series.

Table 3 *Unit root test on rice price series in different market places in Vietnam*

Market place	Observations.	Unit root-test on price levels			Unit root-test on first differences		
		ADF [1]	δ	t-value [2]	ADF [1]	δ	t-value [2]
Angiang (AG)	188	ADF (1)	- 0.057	- 1.992	ADF (1)	- 1.517	- 13.064
Cantho (CT)	187	ADF (1)	- 0.032	- 1.489	ADF (0)	- 1.264	- 17.944
Danang (DN)	188	ADF (1)	- 0.081	- 2.81	ADF (0)	- 1.109	- 15.308
HCM City	188	ADF (0)	- 0.064	- 2.48	ADF (1)	- 1.383	- 12.519
Hanoi (HN)	188	ADF (0)	- 0.058	- 2.357	ADF (0)	- 1.208	- 16.961
Lamdong (LD)	185	ADF (0)	- 0.025	- 2.232	ADF (0)	- 1.103	- 15.213
Soctrang (ST)	188	ADF (2)	- 0.036	- 1.551	ADF (1)	- 1.339	- 12.417
Tiengiang (TG)	188	ADF (2)	- 0.023	- 1.025	ADF (1)	- 1.560	- 13.603
VN Export	186	ADF (1)	- 0.029	- 1.431	ADF (0)	- 1.315	- 18.827

Note: [1] In the column ADF the number of lags that was allowed for in the unit root test is indicated in brackets, based on the Schwartz criterion. ADF analysis was carried out in EVIEWS © 4.1
[2] Critical values are given in Maddala 1992: t = - 2.88, 5% level of significance.

Source: Weekly paddy and rice price series from 1998 to 2001. Cantho Trade Department, Information Centre of the Ministry of Agriculture and Rural Development, and the Ministry of Trade of Vietnam.

The plots of the data give some indications that it is wise to test for the existence of volatility clustering. If we model each series by an appropriate ARMA process the quadratic residuals exhibit no serial correlation. If we fit a Garch model the Schwartz criterion is higher than in case of a simple ARMA model. So we conclude that there is no significant clustering effect in the volatility.

Step 2: Testing for the lag length

We continue to test for the lag length, because the results of co-integration tests can be quite sensitive to this. An obvious procedure is to estimate a vector auto-regression (VAR) on the differenced series. Start with the longest lag length deemed reasonable and test whether the lag length can be shortened. We use the Akaike information criterion (AIC) and Schwarz criterion (SC) to select a suitable lag length. The VAR analysis on first differences shows that the smallest value for both AIC and SC is obtained with lag length 1 (See Appendix 4). The result of the VAR analysis is presented in Table 4 below.

Table 4 *VAR analysis on rice price series in different market places*

	ΔVN(-1)	ΔHCM(-1)	ΔCT(-1)	ΔLD(-1)	ΔTG(-1)	ΔHN(-1)	ΔST(-1)	ΔAG(-1)	ΔDN(-1)
ΔVN	- 0.304 [-4.327]	-	-	-	-	-	-	-	-
ΔHCM	0.169 [2.820]	-0.173 [-2.295]	0.247 [2.744]	-	-	-	-	-	-
ΔCT	0.087 [1.870]	-0.148 [-2.257]	-0.298 [-3.846]	0.106 [1.873]	-	-	-	-	-
ΔLD	0.145 [2.012]	-0.188 [2.074]	-	-0.196 [-2.481]	-	-0.159 [1.792]	-	-	-
ΔTG	0.107 [1.820]	-	0.157 [1.813]	0.138 [2.154]	-0.267 [-3.644]	-	-	-	-
ΔHN	-	0.158 [2.067]	-	-	-	-0.299 [-3.068]	-	-	-
ΔST	-	-	-	-	-	0.126 [1.761]	-0.158 [-1.763]	-	-
ΔAG	-	-	-	-	-	0.148 [1.805]	-	-2.208 [-3.698]	-
ΔDN	-	-	-	0.129 [2.070]	-	-	-	-	-0.178 [-2.406]

Note: The results of the VAR analysis are based on one lag (the AIC and SC are smallest).
All figures in parenthesis […] are t-values, non significant values are omitted

In general, Table 4 indicates that the present price changes in all market places are highly correlated with their own price change in the previous period. The results in the first column indicate that the price changes in most major rice markets in the Mekong River Delta and HCM City are strongly related to changes in the export price.

Step 3: Determine the number of cointegrating equations

The main task in this step is to determine the rank of Π in (2) and to estimate the co-integrating equations. The results of λ_{trace} and λ_{max}, using the Johansen co-integration test available in EVIEWS (Table 5), indicate that the rank of Π is 3 (for both the λ_{trace} and λ_{max} tests at 95% significant level)[6].

Table 5 *Testing for the number of cointegrating relations*

Null Hypothesis	Alternative hypothesis		95% Critical value	99% Critical value
λ_{trace} tests		λ_{trace} value		
r = 0	r > 0	249.80	175.77	187.31
r ≤ 1	r > 1	184.10	141.20	152.32
r ≤ 2	r > 2	134.04	109.99	119.80
r ≤ 3	r > 3	88.91	82.49	90.45
r ≤ 4	r > 4	54.09	59.46	66.52
λ_{max} tests		λ_{max} value		
r = 0	r = 1	65.70	53.69	59.78
r = 1	r = 2	50.05	47.99	53.90
r = 2	r = 3	45.12	41.51	47.15
r = 3	r = 4	34.82	36.36	41.00
r = 4	r = 5	23.55	30.04	35.17

Note: If the value of λ_{trace} and or λ_{max} exceeds the critical value, we reject the null hypothesis and accept the alternative of more co-integrating vectors.

Step 4: Testing for long-run price integration

We focus on the long-run co-integration of price series by analysing the normalised co-integrating coefficients (β). To estimate co-integrating coefficients (β) we use the Johansen co-integration test as implemented in EVIEWS. The co-integrating coefficients β estimated in step 2, r = 3 are presented in Appendix 5. If we normalise with respect to the export price of Vietnam (VN), the prices in HCM City (HCM), and in Cantho (CT), the three normalised co-integrating equations are as follows:

VN = + 3.598 AG – 3.243 ST + 4.250 TG – 3.568 LD – 0.265 DN + 0.497 HN (1)
[-4.387]** [3.804]** [-5.751]** [6.557]*** [0.727] ns [-1.084] ns

HCM = – 1.879 AG + 0.069 ST + 1.266 TG + 0.420 LD + 0.324 DN + 0.734 HN (2)
[5.425]** [0.193] ns [-4.057]** [-1.829]* [-2.099 [3.787]*

CT = – 0.766 AG + 1.136 ST + 0.231 TG + 0.306 LD + 0.115 DN – 0.055 HN (3)
[6.501]*** [-9.276]*** [-2.175]* [-3.911]** [-2.187]* [0.846] ns

Note: All figures in parenthesis […] are t-values;
*** = significant at 1%, ** = significant at 5%, * = significant at 10%, ns = not significant.

[6] Because if we select $r \geq 4$ then the λ_{trace} and λ_{max} value are smaller than the 95% critical value (54.09<59.46 for λ_{trace} and 34.82<36.36 for λ_{max})

The significant coefficients in the co-integrating equations (1) and (2) above indicate that in the long-run most markets in the Mekong River Delta are highly co-integrated with HCM City and especially with the export price of Vietnam. Rice is a major export product for the Mekong River Delta. Therefore, the price formation process in this region highly depends on the government controlled export price. Moreover, HCM City is the major urban centre in the South of Vietnam and, therefore, it was expected to be strongly integrated with the major grain baskets in the South. Two market places, located in the Centre and the North of Vietnam: Danang and Hanoi, are not significantly present in the co-integrating equation (1). This result may be explained by the fact that these markets are no major surplus areas but urban consumer centres. As expected, these markets are related to the price levels observed in HCM City. However, the relationship is somewhat weak. This can be explained by the subsidies used in the framework of the food security policy and the long distance (high marketing costs). Furthermore, co-integrating equation (3) shows that all markets in the Mekong River Delta are highly co-integrated. This result clearly indicates that the rice market system in the South is strongly integrated.

Step 5: Testing for short-run integration with a Vector Error Correction Model

When long-run integration is observed, it can be incorporated in the model, by specifying a Vector Error Correction Model (VECM). This VECM can then be used to estimate the dynamics in the short-run. Using the same price series as in step 3 we obtain the results presented in Appendix 6. The short-run dynamics are presented in Table 6. The numbers presented are the coefficients of the cointegrating relations in the regression for the price changes.

Table 6 Estimate the dynamics in the short-run by using VECM

Er. Correction	D(VN)	D(HCM)	D(CT)	D(AG)	D(ST)	D(TG)	D(LD)	D(DN)	D(HN)
CointEq1	-0.019593	-0.029363	-0.028046	0.012855	0.008991	0.065214	-0.055013	-0.013811	-0.018373
	(0.01899)	(0.01610)	(0.01378)	(0.01723)	(0.01497)	(0.01483)	(0.01840)	(0.01530)	(0.01593)
	[-1.03156]	[-1.82387]	[-2.03566]	[0.74624]	[0.60044]	[4.39619]	[-2.99045]	[-0.90256]	[-1.15367]
CointEq2	0.015752	-0.004872	0.076943	-0.165163	-0.078770	0.036218	-0.018738	0.046136	0.118912
	(0.04449)	(0.03771)	(0.03227)	(0.04035)	(0.03507)	(0.03474)	(0.04309)	(0.03584)	(0.03730)
	[0.35409]	[-0.12921]	[2.38446]	[-4.09353]	[-2.24607]	[1.04241]	[-0.43488]	[1.28725]	[3.18788]
CointEq3	-0.154306	-0.000200	-0.266788	0.101853	0.415107	0.317987	0.181434	0.048756	-0.067354
	(0.13002)	(0.11021)	(0.09431)	(0.11793)	(0.10250)	(0.10155)	(0.12593)	(0.10475)	(0.10902)
	[-1.18677]	[-0.00182]	[-2.82872]	[0.86370]	[4.04976]	[3.13133]	[1.44071]	[0.46543]	[-0.61780]

Note: All figures in parenthesis […] are t-values

Table 6 shows that the four major rice production markets in the Mekong River Delta: Cantho (CT), Angiang (AG), Soctrang (ST) and Tiengiang (TG) strongly react on the long-run co-integrating equations. The partial short-run adjustment of price changes at those market places reacts significantly on the deviation from the long-run equilibrium. Tiengiang is the strongest follower of the co-integrating equation (1) and Angiang is the strongest follower of the co-integrating equation (2), as measured by the coefficients: 0.065214 and 0.165163 for Tiengiang and Angiang respectively. In the co-integrating equation (3) Tiengiang and Soctrang have a stronger reaction than the others (0.415107

and 0.317987). Finally, the Cantho rice market is a special market, as it reacts on all of the three co-integrating equations.

The price changes in the domestic market do not have any measurable influence on the export price: the coefficients of all three cointegrating relations are not significant. Apparently, rice traders in Vietnam have to follow the price set by the Vietnamese government for transactions in the international market. The market of Lamdong (LD), in the Central Highlands, reacts on the cointegrating equation (1), although the significant coefficient is quite low. Prices in Hanoi strongly react on cointegrating relation (2). The market of Danang is the most weakly integrated market.

6. Conclusions

This study analysed the spatial price differences in the rice market of Vietnam in order to understand its functioning. Since 1988 a domestic liberal trade policy is implemented to improve the incentives in the agricultural sector. We observed that price differences are quite volatile, but profitable domestic trade is possible, in particular with HCM City.

The results of market integration analysis showed that all market places under study are integrated in the long run. However, the degree of market integration differs among the markets. In general we observe that the prices between HCM City and the markets in the Mekong River Delta strongly cohere, even in the short run. The other markets are integrated in the long run but the relationship in the short run is relatively weak. The long distance (transport costs and other marketing costs) explains part of this result. Another explanation is found in government policies regarding food security and the buffer stock program. The inter-regional transactions operated by the SOEs are based on administrative prices and subsidies. The upshot is that private trade between the North and the South is not profitable and that the price adjustment process between these regions is sluggish. Interestingly, no evidence was found that price differences between the South and the North are regularly larger than the marketing costs (Goletti and Minot, 2000). This shows that the system fulfils the key condition for an economically integrated market, that maximum regional price differences are determined by marketing costs.

The price changes in the domestic market do not have any measurable influence on the export price, even though Vietnam is the world's second largest exporter of rice. This shows that the regulated world market price dominates the domestic price formation process. This was expected as the Mekong River Delta is selling 40% of its rice production on this market. An interesting question, requiring further research, is the relationship between the government policy that fixes the export price and price patterns on the world market.

The data support the view that the domestic rice market in Vietnam is highly competitive. However, rice trade between the North and the South is determined by administrative prices making private trade between these regions unprofitable. We also observed that private traders obtained only a very small

percentage of the total export quota. This crucial segment in the rice market is still controlled by state owned food companies. Therefore, we conclude that the privatisation process in this market still faces some major challenges.

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Appendix 1: *Average direct marketing costs to deliver rice from major market places in the Mekong River Delta to HCM City*

(Unit: VND/Ton)

Marketing costs incurred by different Rice traders	Transportation by boat			
	Cantho HCM City (200km)	Angiang HCM City (260 km)	Soctrang HCM City (260 km)	Tiengiang HCM City (90 km)
1. Long-distance assemblers	152,000	199,000	178,000	88,000
Transportation cost [1]	*96,000*	*128,000*	*112,000*	*47,000*
Loading (local)	*4,000*	*4,000*	*4,000*	*4,000*
Unloading (HCM)	*12,000*	*12,000*	*12,000*	*12,000*
Others [2]	*40,000*	*55,000*	*50,000*	*25,000*
2. Brokers in HCM City [3] (commission fee: offering of parking area, negotiation and other selling services)	60,000	60,000	60,000	60,000
3. Wholesalers in HCM City [4]	207,000	207,000	207,000	207,000
Labour costs	*47,000*	*47,000*	*47,000*	*47,000*
Transportation	*40,000*	*40,000*	*40,000*	*40,000*
Management fees (telephone, fax, office supplies)	*45,000*	*45,000*	*45,000*	*45,000*
Tax, licenses	*35,000*	*35,000*	*35,000*	*35,000*
Others [5]	*40,000*	*40,000*	*40,000*	*40,000*
Total	419,000	466,000	445,000	355,000

Note: [1] The estimation of transportation costs for long-distance assemblers is based on the distance between the markets and the results of the survey carried out by Luu T. Duc Hai (2003).

[2] Other costs for long-distance assemblers included losses in quantity and quality of rice; accommodation (e.g. food and drinks); parking fees; extra payments for loading and unloading.

[3] Of which 50% concerns a commission fee and 50% a payment for provided services (derived from rice brokers in Tiengiang and based on the standard of living/salary in HCM City).

[4] These figures are computed based on the results of a survey among wholesalers in the MKD provinces and the standard of living/salary in HCM City.

[5] Other costs for wholesalers concern the depreciation on fixed assets, interest on borrowed capital, losses in quantity and quality of rice.

Source: Estimates derived from Luu T. Duc Hai, 2003

Appendix 2: *Average direct marketing costs to deliver rice from Cantho to other provinces in the central highlands and in the north*

(Unit: VND/Ton)

Marketing costs incurred by different rice traders	Cantho – Lamdong (500 km)	Cantho – Danang (1000 km)	Cantho – Hanoi (1500 km)
1. Long-distance assemblers by boat [1]			
(From Cantho to Tiengiang)	60,000	60,000	60,000
Transportation cost	*38,000*	*38,000*	*38,000*
Loading	*4,000*	*4,000*	*4,000*
Unloading	*4,000*	*4,000*	*4,000*
Others [2]	*14,000*	*14,000*	*14,000*
2. Brokers in Tiengiang market place [3] (commission fee: offering of parking area, negotiation and other selling services)	20,000	20,000	20,000
3. Long-distance assemblers by truck [4]			
(From Tiengiang to different destinations)	179,000	314,000	374,000
Transportation cost	*125,000*	*220,000*	*260,000*
Loading	*4,000*	*4,000*	*4,000*
Unloading	*10,000*	*10,000*	*10,000*
Others [2]	*40,000*	*80,000*	*100,000*
4. Wholesalers of other provinces [5]	115,000	115,000	207,000
Labour costs	*28,700*	*28,700*	*47,000*
Transportation	*20,500*	*20,500*	*40,000*
Management fees (telephone, fax, office supplies)	*27,800*	*27,800*	*55,000*
Tax, licenses	*18,000*	*18,000*	*25,000*
Others [6]	*20,000*	*20,000*	*40,000*
Total	374,000	509,000	661,000

Note: [1] These figures are derived from Luu T. Duc Hai's survey

[2] Other costs for long-distance assemblers include losses in quantity and quality of rice; accommodation (e.g. food and drinks); parking fees; extra payments for loading and unloading.

[3] Of which 50% is a commission fee and 50% concerns a payment for services.

[4] Transportation costs for long-distance assemblers (truck) are based on the distances between markets.

[5] Estimations are based on the results of a survey among wholesalers in the MKD provinces and the standard of living/salary in Lamdong, Danang, and Hanoi.

[6] Other costs for wholesalers concern the depreciation of fixed assets, interest on borrowed capital, losses in quantity and quality of rice.

Source: Estimates derived from Luu T. Duc Hai, 2003

Appendix 3: *Average direct marketing costs for transactions between major market places in the Mekong River Delta.*

(Unit: VND/Ton)

Marketing costs incurred by rice traders	Cantho – Angiang (60 km)	Cantho – Soctrang (60 km)	Cantho – Tiengiang (110 km)	Angiang – Soctrang (120 km)	Angiang – Tiengiang (170 km)	Soctrang – Tiengiang (170 km)
1. Distance assemblers by boat [(1)]	46,500	46,500	60,000	54,000	74,000	74,000
Transportation cost	*32,000*	*32,000*	*38,000*	*36,000*	*50,000*	*50,000*
Loading	*4,000*	*4,000*	*4,000*	*4,000*	*4,000*	*4,000*
Unloading	*4,000*	*4,000*	*4,000*	*4,000*	*4,000*	*4,000*
Others [(2)]	*6,500*	*6,500*	*14,000*	*10,000*	*16,000*	*16,000*
2. Wholesalers of other provinces	115,000	115,000	115,000	115,000	115,000	115,000
Labour costs	*28,700*	*28,700*	*28,700*	*28,700*	*28,700*	*28,700*
Transportation	*20,500*	*20,500*	*20,500*	*20,500*	*20,500*	*20,500*
Management fees (telephone, fax, office supplies)	*27,800*	*27,800*	*27,800*	*27,800*	*27,800*	*27,800*
Tax, licenses	*18,000*	*18,000*	*18,000*	*18,000*	*18,000*	*18,000*
Others [(3)]	*20,000*	*20,000*	*20,000*	*20,000*	*20,000*	*20,000*
Total	161,500	161,500	175,000	169,000	189,000	189,000

Note: [(1)] These figures are derived from Hai's survey and based on the distance between different market places.

[(2)] Other costs for distance assemblers include losses in quantity and quality of rice; accommodation (e.g. food and drinks); parking fees; extra payments for loading and unloading.

[(3)] Other costs for wholesalers concern the depreciation on fixed assets, interest on borrowed capital, losses in quantity and quality of rice.

Source: Luu T. Duc Hai, 2003

Appendix 4 *Vector Auto Regression Estimates*

	DAG	DCT	DDN	DHCM	DHN	DLD	DST	DTG	DVN
DAG(-1)	-0.285287	0.078106	-0.039787	0.070749	-0.092429	0.057910	0.046693	-0.051553	0.070922
	(0.07713)	(0.06015)	(0.06610)	(0.06935)	(0.07019)	(0.08333)	(0.06726)	(0.06780)	(0.08109)
	[-3.69875]	[1.29863]	[-0.60190]	[1.02015]	[-1.31688]	[0.69492]	[0.69423]	[-0.76040]	[0.87466]
DCT(-1)	0.120593	-0.298525	0.139565	0.247117	0.049224	-0.000644	0.053483	0.157961	0.140961
	(0.09907)	(0.07725)	(0.08490)	(0.08908)	(0.09015)	(0.10704)	(0.08639)	(0.08708)	(0.10415)
	[1.21726]	[-3.86428]	[1.64382]	[2.77417]	[0.54601]	[-0.00601]	[0.61908]	[1.81395]	[1.35345]
DDN(-1)	0.031746	0.058827	-0.178542	-0.083241	-0.106308	-0.004285	-0.112908	0.011978	0.124947
	(0.08656)	(0.06750)	(0.07418)	(0.07783)	(0.07877)	(0.09352)	(0.07548)	(0.07609)	(0.09100)
	[0.36675]	[0.87155]	[-2.40680]	[-1.06953]	[-1.34963]	[-0.04582]	[-1.49584]	[0.15743]	[1.37308]
DHCM(-1)	-0.051002	-0.148395	0.109881	-0.173991	0.158599	0.188982	-0.044136	-0.066068	-0.059960
	(0.08431)	(0.06574)	(0.07225)	(0.07581)	(0.07672)	(0.09109)	(0.07352)	(0.07411)	(0.08863)
	[-0.60493]	[-2.25718]	[1.52075]	[-2.29518]	[2.06722]	[2.07469]	[-0.60032]	[-0.89151]	[-0.67649]
DHN(-1)	0.148370	0.046787	0.028519	0.057349	-0.229403	0.159118	0.126215	0.112946	0.030239
	(0.08216)	(0.06407)	(0.07041)	(0.07388)	(0.07477)	(0.08877)	(0.07165)	(0.07222)	(0.08638)
	[1.80579]	[0.73026]	[0.40502]	[0.77628]	[-3.06822]	[1.79248]	[1.76161]	[1.56390]	[0.35008]
DLD(-1)	-0.101030	0.106890	0.129809	-0.046020	0.000944	-0.196173	0.070398	0.138538	0.019008
	(0.07317)	(0.05705)	(0.06270)	(0.06579)	(0.06658)	(0.07905)	(0.06380)	(0.06431)	(0.07692)
	[-1.38085]	[1.87352]	[2.07021]	[-0.69953]	[0.01417]	[-2.48168]	[1.10339]	[2.15417]	[0.24712]
DST(-1)	0.116225	0.127112	0.062272	-0.010497	0.037846	0.143204	-0.158688	0.002670	0.032729
	(0.10318)	(0.08046)	(0.08842)	(0.09277)	(0.09389)	(0.11147)	(0.08997)	(0.09069)	(0.10847)
	[1.12646]	[1.57989]	[0.70424]	[-0.11315]	[0.40309]	[1.28464]	[-1.76373]	[0.02944]	[0.30174]
DTG(-1)	0.007814	0.037677	-0.003937	-0.088467	0.049917	-0.091992	0.029133	-0.267948	-0.081426
	(0.08365)	(0.06523)	(0.07169)	(0.07521)	(0.07612)	(0.09038)	(0.07294)	(0.07353)	(0.08794)
	[0.09342]	[0.57761]	[-0.05492]	[-1.17621]	[0.65576]	[-1.01787]	[0.39939]	[-3.64415]	[-0.92593]
DVN(-1)	0.064492	0.087290	0.085996	0.169892	0.058097	0.145715	0.023627	0.107221	-0.304827
	(0.06700)	(0.05225)	(0.05742)	(0.06024)	(0.06097)	(0.07239)	(0.05843)	(0.05889)	(0.07044)
	[0.96254]	[1.67071]	[1.49764]	[2.82003]	[0.95286]	[2.01292]	[0.40439]	[1.82056]	[-4.32761]

Appendix 4 *(Continued)*

	DAG	DCT	DDN	DHCM	DHN	DLD	DST	DTG	DVN
R-squared	0.129703	0.169797	0.098184	0.125352	0.092792	0.091183	0.059097	0.127137	0.131106
Adj. R-squared	0.090367	0.132274	0.057424	0.085820	0.051788	0.050107	0.016570	0.087685	0.091834
Sum sq. resids	3720154.	2262088.	2732319.	3007630.	3080583.	4342499.	2828869.	2874320.	4111459.
S.E. equation	144.9752	113.0494	124.2450	130.3544	131.9258	156.6330	126.4212	127.4327	152.4093
F-statistic	3.297348	4.525103	2.408841	3.170885	2.263005	2.219841	1.389640	3.222613	3.338397
Log likelihood	-1184.951	-1138.685	-1156.250	-1165.178	-1167.407	-1199.336	-1159.479	-1160.962	-1194.252
Akaike AIC	12.83818	12.34070	12.52957	12.62557	12.64953	12.99287	12.56429	12.58023	12.93819
Schwarz SC	12.99426	12.49679	12.68565	12.78165	12.80562	13.14895	12.72038	12.73632	13.09428
Mean dependent	0.806452	-2.150538	-0.107527	-0.376344	-0.376344	-2.849462	-0.537634	-0.806452	-4.796774
S.D. dependent	152.0060	121.3603	127.9738	136.3357	135.4806	160.7111	127.4818	133.4162	159.9295
Determinant Residual Covariance		7.33E+37							
Log Likelihood (d.f. adjusted)		-10483.75							
Akaike Information Criteria		113.5995							
Schwarz Criteria		115.0043							

Note: (1) Included observations: 186. Excluded observations: 3 after adjusting endpoints.
(2) Standard errors in ( ) & t-statistics in [ ]

Appendix 5 *Johansen Co-integration Test*
Normalised co-integrating coefficients (standard error in parentheses)

Co-integrating equation	VN	HCM	CT	AG	ST	TG	LD	DN	HN
(1)	1.000000	0.000000	0.000000	-3.598265	3.243148	-4.250613	3.568764	0.265870	-0.497459
				(0.81548)	(0.84762)	(0.73482)	(0.54112)	(0.36356)	(0.45613)
(2)	0.000000	1.000000	0.000000	1.879818	-0.069662	-1.266777	-0.420700	-0.324372	-0.734023
				(0.34451)	(0.35809)	(0.31044)	(0.22861)	(0.15359)	(0.19270)
(3)	0.000000	0.000000	1.000000	0.766660	-1.136914	-0.231148	-0.306059	-0.115016	0.055629
				(0.11724)	(0.12186)	(0.10565)	(0.07780)	(0.05227)	(0.06558)
Adjustment coefficients (std.err. in parentheses)									
D(VN)	-0.019593	0.015752	-0.154306						
	(0.01889)	(0.04423)	(0.12928)						
D(HCM)	-0.029363	-0.004872	-0.000200						
	(0.01601)	(0.03749)	(0.10958)						
D(CT)	-0.028046	0.076943	-0.266788						
	(0.01370)	(0.03208)	(0.09378)						
D(AG)	0.012855	-0.165163	0.101853						
	(0.01713)	(0.04012)	(0.11725)						
D(ST)	0.008991	-0.078770	0.415107						
	(0.01489)	(0.03487)	(0.10192)						
D(TG)	0.065214	0.036218	0.317987						
	(0.01475)	(0.03455)	(0.10097)						
D(LD)	-0.055013	-0.018738	0.181434						
	(0.01829)	(0.04284)	(0.12522)						
D(DN)	-0.013811	0.046136	0.048756						
	(0.01521)	(0.03564)	(0.10416)						
D(HN)	-0.018373	0.118912	-0.067354						
	(0.01584)	(0.03709)	(0.10840)						

Appendix 6 *Vector Error Correction Estimates*

	D(VN)	D(HCM)	D(CT)	D(AG)	D(ST)	D(TG)	D(LD)	D(DN)	D(HN)
CointEq1	-0.019593	-0.029363	-0.028046	0.012855	0.008991	0.065214	-0.055013	-0.013811	-0.018373
	(0.01899)	(0.01610)	(0.01378)	(0.01723)	(0.01497)	(0.01483)	(0.01840)	(0.01530)	(0.01593)
	[-1.03156]	[-1.82387]	[-2.03566]	[0.74624]	[0.60044]	[4.39619]	[-2.99045]	[-0.90256]	[-1.15367]
CointEq2	0.015752	-0.004872	0.076943	-0.165163	-0.078770	0.036218	-0.018738	0.046136	0.118912
	(0.04449)	(0.03771)	(0.03227)	(0.04035)	(0.03507)	(0.03474)	(0.04309)	(0.03584)	(0.03730)
	[0.35409]	[-0.12921]	[2.38446]	[-4.09353]	[-2.24607]	[1.04241]	[-0.43488]	[1.28725]	[3.18788]
CointEq3	-0.154306	-0.000200	-0.266788	0.101853	0.415107	0.317987	0.181434	0.048756	-0.067354
	(0.13002)	(0.11021)	(0.09431)	(0.11793)	(0.10250)	(0.10155)	(0.12593)	(0.10475)	(0.10902)
	[-1.18677]	[-0.00182]	[-2.82872]	[0.86370]	[4.04976]	[3.13133]	[1.44071]	[0.46543]	[-0.61780]
D(VN(-1))	-0.294609	0.188498	0.098271	0.067294	0.025631	0.066463	0.182379	0.092102	0.061805
	(0.07159)	(0.06068)	(0.05193)	(0.06493)	(0.05644)	(0.05591)	(0.06934)	(0.05768)	(0.06003)
	[-4.11520]	[3.10634]	[1.89240]	[1.03640]	[0.45414]	[1.18867]	[2.63023]	[1.59685]	[1.02960]
D(HCM(-1))	-0.063935	-0.185644	-0.188276	0.063750	-0.029706	-0.094788	0.153390	0.063733	0.070579
	(0.09360)	(0.07934)	(0.06789)	(0.08489)	(0.07379)	(0.07310)	(0.09066)	(0.07541)	(0.07848)
	[-0.68308]	[-2.33998]	[-2.77312]	[0.75096]	[-0.40259]	[-1.29665]	[1.69201]	[0.84518]	[0.89930]
D(CT(-1))	0.217139	0.248675	-0.170166	0.080025	-0.147447	-0.004309	-0.087135	0.113074	0.075830
	(0.12229)	(0.10366)	(0.08871)	(0.11091)	(0.09641)	(0.09551)	(0.11844)	(0.09852)	(0.10254)
	[1.77561]	[2.39905]	[-1.91832]	[0.72151]	[-1.52944]	[-0.04511]	[-0.73566]	[1.14768]	[0.73952]
D(AG(-1))	0.076027	0.009031	0.056619	-0.153626	-0.033593	-0.066194	-0.123489	-0.131050	-0.210171
	(0.09410)	(0.07976)	(0.06826)	(0.08535)	(0.07418)	(0.07349)	(0.09114)	(0.07581)	(0.07890)
	[0.80793]	[0.11322]	[0.82949]	[-1.80003]	[-0.45283]	[-0.90067]	[-1.35491]	[-1.72860]	[-2.66368]
D(ST(-1))	-0.030440	0.024451	0.010702	0.158753	0.063586	0.102881	0.310611	0.105853	0.021456
	(0.12586)	(0.10668)	(0.09129)	(0.11415)	(0.09922)	(0.09830)	(0.12190)	(0.10140)	(0.10553)
	[-0.24187]	[0.22920]	[0.11723]	[1.39078]	[0.64088]	[1.04665]	[2.54813]	[1.04396]	[0.20332]
D(TG(-1))	-0.123729	-0.143310	0.010557	-0.075967	0.040313	-0.087862	-0.178784	0.011327	0.095057
	(0.09914)	(0.08404)	(0.07192)	(0.08992)	(0.07816)	(0.07743)	(0.09603)	(0.07988)	(0.08313)
	[-1.24798]	[-1.70534]	[0.14680]	[-0.84483]	[0.51578]	[-1.13469]	[-1.86183]	[0.14181]	[1.14346]
D(LD(-1))	0.034156	0.006736	0.126023	-0.121752	0.106187	0.067203	-0.072786	0.164799	0.033189
	(0.08228)	(0.06974)	(0.05968)	(0.07463)	(0.06487)	(0.06426)	(0.07969)	(0.06629)	(0.06899)
	[0.41511]	[0.09658]	[2.11148]	[-1.63147]	[1.63701]	[1.04573]	[-0.91331]	[2.48598]	[0.48105]
D(DN(-1))	0.120899	-0.071055	0.050150	0.032089	-0.084295	0.010983	0.033105	-0.168120	-0.102259
	(0.09176)	(0.07778)	(0.06656)	(0.08322)	(0.07234)	(0.07166)	(0.08887)	(0.07392)	(0.07694)
	[1.31760]	[-0.91359]	[0.75348]	[0.38559]	[-1.16533]	[0.15326]	[0.37250]	[-2.27420]	[-1.32911]
D(HN(-1))	0.035225	0.036667	0.072440	0.103995	0.074258	0.137298	0.101610	0.027274	-0.204015
	(0.08866)	(0.07515)	(0.06431)	(0.08042)	(0.06990)	(0.06925)	(0.08588)	(0.07143)	(0.07434)
	[0.39728]	[0.48790]	[1.12634]	[1.29322]	[1.06238]	[1.98267]	[1.18321]	[0.38182]	[-2.74419]

Appendix 6 (Continued)

	D(VN)	D(HCM)	D(CT)	D(AG)	D(ST)	D(TG)	D(LD)	D(DN)	D(HN)
R-squared	0.139313	0.149082	0.213558	0.216272	0.158148	0.245581	0.200420	0.127508	0.156764
Adj. R-squared	0.084902	0.095289	0.163840	0.166726	0.104928	0.197888	0.149872	0.072350	0.103456
Sum sq. resids	4072623.	2926028.	2142851.	3350108.	2531067.	2484287.	3820543.	2643475.	2863354.
S.E. equation	152.9898	129.6775	110.9740	138.7570	120.6083	119.4885	148.1794	123.2574	128.2812
F-statistic	2.560373	2.771373	4.295410	4.365069	2.971562	5.149180	3.964942	2.311698	2.940721
Log likelihood	-1193.369	-1162.620	-1133.649	-1175.207	-1149.134	-1147.399	-1187.427	-1153.175	-1160.606
Akaike AIC	12.96096	12.63032	12.31881	12.76567	12.48531	12.46666	12.89707	12.52877	12.60867
Schwarz SC	13.16907	12.83843	12.52692	12.97378	12.69343	12.67477	13.10518	12.73688	12.81678
Mean dependent	-4.796774	-0.376344	-2.150538	0.806452	-0.537634	-0.806452	-2.849462	-0.107527	-0.376344
S.D. dependent	159.9295	136.3357	121.3603	152.0060	127.4818	133.4162	160.7111	127.9738	135.4806
Determinant Residual Covariance		3.60E+37							
Log Likelihood		-10361.80							
Log Likelihood (d.f. adjusted)		-10417.62							
Akaike Information Criteria		113.4690							
Schwarz Criteria		115.8103							

Note: (1) Included observations: 186. Excluded observations: 3 after adjusting endpoints.
(2) Standard errors in ( ) & t-statistics in [ ]