Working Paper No. 57

Competitiveness and efficiency in poultry and pig production in Vietnam

Socio-economics and Policy Research

ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

International Livestock Research Institute

Competitiveness and efficiency in poultry and pig production in Vietnam

Socio-economics and Policy Research Working Paper 57

S. Akter, M.A. Jabbar and S.K. Ehui

ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

International Livestock Research Institute
P.O. Box 30709, Nairobi, Kenya

SePR Working Papers contain results of research done by ILRI scientists, consultants and collaborators. The Working Papers are not subjected to full refereeing and are disseminated to motivate discussion and comment. It is expected that most of the Working Papers will be published in some other form. The author(s) alone is (are) responsible for the contents.

Authors' affiliations

Shaheen Akter, Shahjalal University of Science and Technology, Sylhet, Bangladesh (Current address: PNG Unitech, Lae, Morobe Province, Papua New Guinea)
Mohammad A. Jabbar, International Livestock Research Institute (ILRI), P.O. Box 5689, Addis Ababa, Ethiopia
Simeon K. Ehui, ILRI, P.O. Box 5689, Addis Ababa, Ethiopia

ISBN 92–9146–159–8

Correct citation: Akter S., Jabbar M.A. and Ehui S.K. 2003. Competitiveness and efficiency in poultry and pig production in Vietnam. Socio-economics and Policy Research Working Paper 57. ILRI (International Livestock Research Institute), Nairobi, Kenya. 61 pp.

Table of Contents

List of Tables

List of Figures

Acknowledgements

The authors are grateful to the Government of Denmark, the Asian Development Bank, the International Food Policy Research Institute (IFPRI), and the International Livestock Research Institute (ILRI) for providing funding for different stages of this work. Lucila Lapar, Francesco Goletti and S.M. Fakhrul Islam made useful comments on an earlier draft. The authors alone are responsible for the content.

Abstract

Competitiveness and efficiency of local, crossbred and exotic breeds of poultry and pig production in North and South Vietnam were assessed using data from a stratified sample of 2213 farms collected in 1999. Results of policy analysis matrix show that poultry meat and egg production is generally competitive except meat and egg production with local breeds, and egg production with crossbreds in the North, and egg production with local breeds in the South, due to low productivity and high per unit cost. There are economies of scale in the North but it is not so clear in the South. Domestic prices of both outputs and inputs are higher than the world prices. If output prices fall moderately due to with- drawal of protective policies and domestic demand slows down from the current high levels, poultry breeds that are profitable under the existing situation would still remain competitive. Pig production under existing technologies and market conditions is highly competitive, especially with local and crossbreds in the North and exotic breeds in the South. Currently, producers in the South are apparently benefiting more due to market conditions and policy that make input cost higher and output price lower in the North.

There are economies of scale in production, more in case of pig than in poultry. Medium farms are more cost effective, and small farms are least competitive. Several factors including feed quality and management, education of the household head, access to credit, access to government supplied inputs and services, number of extension visits, access to secondary markets significantly influenced the level of efficiency of individual farms. Policy and institutional arrangements that address these factors, especially with targeted support to small farms, will lead to improved overall efficiency. Otherwise, smallholders are likely to be pushed out of business in a more liberalised economic environment.

1 Background and objectives

The government of Vietnam has recently adopted an agricultural diversification programme, which gives substantial priority to the development of the livestock sector. The questions are: (1) whether livestock production will remain competitive with the outside world in playing a significant role in rural income diversification, (2) whether small- holders will remain efficient and competitive to stay in business and reap the benefits of the rapid growth in demand for livestock products, and (3) what policy, institutional and technological options might be needed to facilitate diversification through livestock in order to help smallholders participate in the process.

The reason for adopting the diversification strategy is that while Vietnam experienced rapid economic growth during the 1980s and 1990s because of the economic renewal programme (doi moi), it has also been experiencing a slowdown in recent years (World Bank 2000). Impressive gains in agriculture were initially achieved through enhanced rice production and export. When the slowdown in the growth process was foreseen, reform measures were initiated in favour of agricultural diversification following the experiences of other Asian rice economies. Three main reasons led to such a strategy of rural development. First, the prospect for growth through rice production alone was limited. Large declines in world prices of agricultural commodities including rice re- sulted in a contraction of outputs. Growth in the demand of rice for both domestic consumption and export became slower. Second, rapid growth in income coupled with population growth and urbanisation led to increased domestic demand for food of di- versified origins, especially animal products, as is the case elsewhere in the developing world (Delgado et al. 1999). Third, any sustainable development required not only higher but stable growth in incomes. Stabilisation of rural income was, thus, impossible through rice production alone because of uncertainties in production and price factors.

The development of the livestock sector has been considered a major component in the diversification programme not only to respond to increased urban demand for livestock products but also as a source of higher, stable incomes and better nutrition for rural people. Livestock are often regarded as sources of higher value-added per unit of investment than is the case with crop-based agriculture. They can serve as engines of growth by generating significant farm cash income. Smallholders often cope with crisis by selling livestock assets. Further, the development of livestock can markedly improve the protein and micronutrient deficiencies prevalent among the population. Meat, egg and milk consumption in Vietnam increased at an average annual rate of 4.4, 5.2 and 16.4%, respectively, during the 1990–99 period. Yet, average consumption of meat was only about 22 kg/capita per year, which is lower than the average for Asia as well as the developing world (FAO 1999; ILRI 2000; Lich 2000; MARD 2000a). Although income growth and income elasticity of demand for meat are high, the real prices of livestock products demonstrated a declining trend (MARD 2000b), producers have the opportunity to boost their incomes through more efficient production and thereby contribute to the growth of both demand and supply.

In the past, demand growth has been met principally from domestic production. Chicken and pig are the most important species. In recent years, commercial production through both private and public sector initiatives has increased but the smallholders remain the principal supply source. Poultry population grew at an average of 6.5% per year but offtake grew at only 0.4% per year. For pigs, herd size grew at the rate of 5% per year but offtake grew at only 1.9% per year. The majority of the producers are small- holders who raise mostly local breeds and some crossbreds and earn 73% of agricultural income from livestock. Smallholders have about 80% local breeds in their chicken inven- tory. Only 10% of the smallholders keep exotic pigs (IFPRI 2001). Thus, there is a poten- tial for growth in supplies through the adoption of improved breeds and increased pro- ductivity.

One of the major constraints to production is the poor quality and high price of feed. With the increase in commercial livestock production, demand for feed quality and quan- tity is increasing. Consequently, commercial feed production has increased at a rate of over 23% during 1988–98, yet it comprises only 22.2% of the diet of commercial poultry and pig production compared to the world average of about 50% (Lich 2000).

Locally produced feeds have an average of 58% imported ingredients, which are subject to import duties. Import duties amount to 5–7% on maize, 30% on soybeans and 10% on fishmeal. Consequently, the domestic price of feed is 1.5–2 times higher than world prices (MARD 2000a; IFPRI 2001) or 10–20% higher than in other Asian countries (Lich 2000). Though feed prices have shown a downward trend recently due to increased domestic production, policy-induced higher feed price remains one of the reasons for the low adoption of improved breeds and low productivity.

The economic liberalisation process was very slow until 1999. Protective policies such as high tariff on some items related to livestock production, wider tariff lines, restricted enterprise laws, regulatory and supervisory institutional frameworks and multilateral quota restrictions under the doi moi were likewise still in place. It is expected, however, that the pace of economic liberalisation will increase rapidly in line with global econ- omic reforms.

In this study, the farm level policy analysis matrix (PAM) was used for assessing the competitiveness of different breeds of poultry and pig production, which respectively represent about 15 and 75% of total meat production in the country. Farm-specific tech- nical efficiency was then measured by applying the stochastic frontier production function approach on both pig and poultry production to identify factors that influence efficiency and assess potential room for improving efficiency. The sampling procedure and some general characteristics of the samples are presented in Section 2. In Section 3, the meth- odology and results of PAM analysis are presented. In Section 4, the methodology and results of frontier production functions are discussed. Summary and conclusion are presented in Section 5.

2 Sampling and some general characteristics of the samples

2.1 Sampling and data collection

A nationwide survey was conducted among pig and poultry producers in 1999–2000 (IFPRI 2001). In general, the North and the South of the country were found to differ significantly in agricultural production practices, prices and income. For example, prices and income were generally higher in the South. There were also significant differences in pig and poultry production. Producers in the North, for instance, produced more local and crossbred poultry and pig while those in the South produced more exotic and cross- breds. Average sizes of poultry and pig farms were also higher in the South. Therefore, separate samples were drawn from the two regions covering 29 provinces. These provinces covered four agro-ecological zones in each region: Red River Delta, North-East, North- West and North Central Coast in the North and South Central Coast, Central High- lands, North-East South and Mekong River Delta in the South. The central region of the country bordering the North and the South regions did not have significant commercial pig and poultry production; therefore, these areas were not included in the sample.

Based on secondary data from the Ministry of Agriculture and Rural Development (MARD) and provincial agricultural departments, total numbers of pig and poultry farms according to size (small, medium and large) in the selected provinces were derived. Samples were then chosen using a stratified sampling approach based on relative pro- portion across provinces and sizes. This gave a total of 1118 poultry and 1962 pig farms. In all, 212 poultry farms were specialised in poultry and 707 pig farms were specialised in pig production; other farms had a mix of pig and poultry but the latter was a minor enterprise.

Data were collected from August 1999 to January 2000 through a single visit survey using a formal questionnaire, which was earlier pre-tested extensively to accommodate regional diversities in production situations and practices. Staff of the Ministry of Agriculture and Rural Development and research institutions trained and supervised by the research team conducted the surveys. Separate survey teams were formed for the two regions.

2.2 Some general characteristics of the samples

After data collection, some farms were found to belong to a slightly different size category perhaps because of the change in inventory by the time of the survey. These farms were thus reclassified for analysis. In the case of poultry, farms having up to 500 birds were classified as small, those with 501–2000 birds as medium and those with over 2000 birds as large. In the case of pig, farms having up to 50 heads of animals were

classified as small, those with 51–100 heads as medium and those with over 100 heads as large. Among the sample poultry farms in the North, 76% were small, 14% were medium and 10% were large while among sample farms in the South, 51% were small, 24% were me- dium and 25% were large. Among the sample pig farms in the North, 71% were small, 17% were medium and 12% were large and among those in the South, 45% were small, 26% were medium and 29% were large.

In the North, 69% of sample poultry farms produced local and 28% produced exotic breeds while in the South, 27% produced local and 55% produced exotic breeds (Table 1). In the North, most farmers produced local or crossbred pigs while in the South most farmers produced exotic or crossbred pigs. In the case of farms producing both pig and poultry, a higher proportion of small and medium farms produced local breeds.

Table 1. Frequency distribution of sample poultry and pig producers by farm size and breed, Vietnam, 1999.

	North (% by breed)			South (% by breed)		
Flock/herd size	Local	Crossbred	Exotic	Local	Crossbred	Exotic
Poultry producers						
Small	86	3	11	49	22	29
Medium	21	4	75	4	18	78
Large	3	3	94	4	9	87
Total	69	3	28	27	18	55
Pig producers						
Small	43	54	3	14	60	26
Medium	60	37	3	8	38	54
Large	13	78	9	1	22	77
Total	42	54	4	8	44	48

Source: IFPRI (2001).

In the case of poultry, producers generally raised a single breed, and only a few farms raised a mixture of breeds. In the case of pig, the pattern was the same except in the North where 44% of the producers raised a mixture of breeds (Table 2).

Table 2. Distribution of sample producers by chicken and pig breeds, Vietnam, 1999.

	Farms by breed mix (%)				
Enterprise	Only local	Only crossbred	Only exotic	Mixed breeds	Total
Chicken					
North	67.5	3	24.9	4.6	100
South	21.7	17.4	56.5	4.4	100
Pig					
North	5.6	48.5	1.6	44.3	100
South	6.5	42	47.2	4.3	100

Source: IFPRI (2001).

Among the sample poultry farms, the average value of output per farm is much higher in the South due to a higher rate of adoption of improved breeds (Table 3). Large commercial farms and specialised poultry production are also proportionately higher in the South than in the North.

Table 3. Some characteristics of sample poultry and pig farms, Vietnam, 1999.

	Poultry farms[a]		Pig farms[b]	
Variable	North	South	North	South
Value of output/farm (VND 10^3)[c]	26,370	116,297	37,728	226,445
Value of stock/farm (VND 10^3)[d]	7590	20,638	10,985	100,278
Flock/herd size	1237	3641	100	237
Adult labour available/farm	2.43	2	2.43	2.1
Labour use/farm (person days)	100	265	226	442
Feed use/farm (kg)	3365	17,980	12778	41,149
Crude feed (%)	80	50	96	64
Crude feed produced at home (%)	61	46	56	18
Housing area (m^2)	51	411	86	217
Veterinary cost/farm (VND 10^3)	437	8625	238	3819
Commercial farms (%)	47	69	42	37
Specialised farms (%)[e]	9	55	22	73
Age of farmer (years)	45	44	45	46
Land area/farm (ha)	0.33	0.39	0.34	0.52
Farms used credit (%)	4	10	24	24
Education of household head (level)[f]	3.3	3.3	3.3	3.2
Female headed farms (%)	19	17	20	26
Distance to market (km)	1.3	2.5	1.5	6.9
Produce sold at market place (%)	32	26	0.5	2
Produce sold through contract (%)	3	4	0.3	0
Produce sold at farm gate (%)	65	70	99	98
Inputs from government sources (%)	42	25	32	20
Number of visits by government service providers	0.2	0.2	4	7.9

a. All means except for age of farmer, land area, education of household head, female headed farm and produce sold through contract were significantly different between the regions at <5% level.
b. All means except for credit, education of household head, produce sold through contract and produce sold at market were significantly different between the regions at <5% level.
c. Including change in inventories. In 1999, US$ 1 = 14,008 Vietnamese Dong ().
d. Includes values of annual breeding and young stocks purchased + net stock born in the year (birth – death) + change in breeding stock in the inventory.
e. Have only pig or poultry as against others who had mixed livestock species. Most farms have crop production and other activities but specialisation is defined here only in terms of livestock species.
f. Highest level of education of household head (1 = none, 2 = completed primary, 3 = completed middle school, 4 = completed high school, 5 = completed technical school, 6 = Some university/college education, 7 = completed university/college).

Source: IFPRI (2001).

The producers in the North use a lower average quantity of input and also produce less. In terms of feed composition, the use of crude materials and fodder crops is proportionately much higher in the North. The use of home-produced feed is also higher in the North. Veterinary cost is much higher in the South.

The average age of farmers and average size of cultivated land are about the same in both regions. Average flock size is much lower in the North. A higher proportion of farms in the South are commercial and specialised farms. A higher proportion of farms in the South use credit. On average, the nearest major market from home is closer in the North than in the South and a higher proportion of produce in the North is sold at the market place. Contract sale is still rare in both regions. Veterinary inputs and stocks from government sources, e.g. government enterprises and the Ministry of Agriculture, and from co-operatives are used by more farmers in the North than in the South, but the average visits from the extension and veterinary services department, other government enterprises and co-operatives are less in the North than in the South.

Among the sample pig farms, the average value of pig production per household is much higher in the South due to a higher rate of adoption of improved breeds (Table 3). This adoption made cost of veterinary drugs and services much higher in the region. The producers in the North use a lower average quantity of input because they produce mainly local breeds. The use of concentrate feed is much lower and home produced feed is much higher in the North for the same reason.

3 Competitiveness in poultry and pig production

3.1 Analytical method

The policy analysis matrix (PAM) approach was used to evaluate the competitiveness of poultry and pig production in Vietnam compared to imports from an open global market. The competitiveness of poultry and pig compared to domestic production of other agricultural commodities is not, however, the subject of this paper. The approach was employed due to its simple and understandable nature, particularly to policy makers. However, its shortcomings are also , such as its inability to predict future changes and long-run behaviour, to adequately address institutional factors that have a non-price effect (Monke and Pearson 1989; Staal and Shapiro 1996), to address the difficulties of determining social prices to be used in the model and to investigate dynamic phenom- ena (Gotsch 1989). The PAM is essentially a double-accounting technique that summar- ises budgetary information for farm and post-farm activities. The methodology begins by constructing farm level commodity budgets that are its building blocks. It evaluates the competitiveness of relevant commodities by comparing data from the private and social budgets. The standard PAM structure is given in Table 4.

Table 4. The policy analysis matrix (PAM).

		Costs		
	Revenues	Tradable inputs	Domestic factors	Profits
Private prices	A	B	C	D
Social prices	E	F	G	H
Effects of divergences and efficient policy	I	J	K	L

where: D = A – B – C = Private profits
H = E – F – G = Social profits
I = A – E = Output divergences
J = B – F = Input divergences
K = C – G = Factor divergences
L = D – H = I – J – K = Net divergences.
Source: Monke and Pearson (1989).

While private profits are estimated based on market prices, social profits are estimated on the basis of social prices. Theoretically, social prices are those that would exist in a perfect market situation. Practically, such prices are estimated using different methods such as: identification of quantifiable market interventions that make the differences in the observed and free market price, calculation of border equivalent or parity prices, and estimation of shadow prices (Gittinger 1982; Monke and Pearson 1989; Staal 1995;

Yao 1997). In this study, import parity prices are used for the items that have domestic prices above the range of non-tradability and export parity prices for the items that have dom- estic prices below the range of non-tradability area.[1] The shadow prices of domestic non- tradable factors are based on their value under the most common alternative activity (Chenery 1961).

Based on the values in the matrix, ratio indicators of comparative advantage, protec- tion and policy impacts are assessed. The commonly used indicators are as follows:

- Private-cost ratio, PCR = C/(A – B)
- Domestic resource cost ratio, DRC = G/(E – F)
- Nominal protection coefficient, NPC on tradable outputs, NPCO = A/E
- Nominal protection coefficient, NPC on tradable inputs, NPCI = B/F
- Effective protection coefficient, EPC = (A – B)/(E – F).

The PCR is the ratio of domestic factor costs (C) to value added in observed prices (A – B). The break-even value of PCR is unity, where D = 0 and the producer still re- mains competitive. The producers earn excess profit when the PCR is less than unity. When it is greater than unity, it implies negative private profits and high factor costs. The DRC serves as a proxy measure of social profits and therefore measures efficiency or comparative advantage.[2] It is the cost of domestic resources in social prices needed to produce a unit of value added. DRC = 1 is analogous to the profitability measure H = 0. Thus, minimising PCR and DRC are equivalent to maximising private and social profits, respectively. In cross-country comparison, DRC can serve as a measure of the relative efficiency of domestic resource use (Fox et al. 1990). Thus, DRC < 1 implies that foreign exchange is gained and a country has a comparative advantage in producing the com- modity. Conversely, DRC > 1 implies that foreign exchange is lost in producing the com- modity.

NPC is a ratio that contrasts the observed commodity price with a comparable world price. Any divergence between these prices indicates market inefficiency due to policy. NPCO < 1 indicates implicit tax on production, and NPCO > 1 indicates implicit sub- sidy on production. In contrast, NPCI < 1 indicates implicit subsidy on input, and NPCI > 1 indicates implicit tax on input. EPC is the ratio of value added in private prices to value added in world prices, indicating the effect of protection on value added. It combines the two NPCs to assess the overall effect of implicit tax and subsidy on out- put and inputs.

For the present study, the activity budgets were prepared from primary data obtained through the survey of pig and poultry producers. All costs were separated as

1. The price range from export parity price to import parity price for a commodity is defined as a range within which the commodity is a non-traded or home good (Dornbusch 1980; Staal 1995).
2. Comparative advantage refers to economic efficiency of different kinds of production within the domestic economy, which are compared in terms of earning or saving a unit of foreign exchange. A second definition of comparative advantage, which is implied in the first one and vice versa, compares the efficiency of production among two or more trading nations, where those with lowest opportunity costs are relatively more efficient and have a comparative advantage.

tradable and domestic categories as per the PAM format.[3] Social prices for different items were estimated using secondary data as discussed below.

3.1.1 Poultry meat

The social value of an internationally traded commodity is its border-equivalent price. The world market price, when translated into parity prices through appropriate addition or deduction of transfer and processing costs, results in border price. In this study, im- port and export parity prices for poultry meat were calculated based on 1996–98 North Central American CIF and FOB prices that were considered the most competitive world market prices. After the addition or deduction of transfer and processing costs, the prices were then converted to Vietnamese Dong (VND) using official exchange rates, and sub- sequently converted to constant prices by deflating with the average annual growth of gross domestic product (GDP) deflator for the period 1990–98. The export–import parity price band ranged from VND 10,572 to 8,496,000/t. They were lower than the private prices for all chicken activities that ranged from VND 11,340 to 16,580,000/t. As such, social price was estimated as import parity price adjusted for local transpor- tation/handling/marketing costs estimated from IFPRI (2001). It may be noted that the Asian FOB price was higher than the CIF price, and this may be due to the large amount of concessional poultry meat imports from North Central America and Europe.

3.1.2 Poultry egg

Import and export parity prices were calculated similarly but based on Asian CIF and FOB prices. The estimated band was VND 11,464–7,883,000/t. This was lower than observed prices except for exotic chicken egg in the North (which fell in the non-traded area). Given this, we used the import parity price as the equivalent of social price except in the case of exotic egg in the North where the domestic price was used as the proxy for social price. The data on observed prices for egg were collected on a per piece basis, and thus weights of 0.5, 0.55 and 0.6 gm per piece were used to convert to the price per tonne of local, crossbred and exotic chicken egg, respectively (MARD 2000a).

3.1.3 Live pig and pig meat

Import and export parity prices of live pig were calculated based on Asian CIF and FOB prices and the estimated band was VND 1171–1,094,000/head. The price of pig meat was calculated based on the assumed average yield of 73 kg live weight per head and

3. Labour and housing area are basic domestic factors. The intermediate inputs were decomposed into tradable and non-tradable components based on border prices. Except for local poultry in the North, more than 90% of the inputs were tradable. For pig, proportionate tradable and non-tradable components varied between farm sizes.

60% recovery for Asia (ILRI 2000) and the estimated band was VND 9624–8,992,000/t. The social price of pig in the North was export parity price for local and crossbred adjusted for local transportation, handling and marketing costs estimated from IFPRI (2001). The private prices of exotic pig in the North were in the non-traded area. The private prices of pig in the South were higher than import parity price and therefore their social prices were import parity price adjusted for local transportation, handling and marketing costs estimated from IFPRI (2001).

3.1.4 Feed items

The calculated import–export price band for maize was VND 1527–1,018,000/t, and the market price ranged from VND 1660 to 1,650,000/t, and the import parity price was used as the social price. World prices for rice bran, milling by-products, soybean cake meal, oilseed meal and groundnut meal were also much higher than domestic prices. For cassava and other roots and tubers, domestic prices were found in the non-tradable area (Scott et al. 2000). For concentrate feed, the social price was assumed to be 20% lower than the market price.

3.1.5 Labour

Labour was the most important domestic factor. The farm survey indicated wages to be VND 22 thousand per day in the South, VND 13 thousand per day in the North, and the mean wage to be VND 18 thousand per day. To stimulate demand, the Government of Vietnam has devised a policy of raising public sector wages (World Bank 2000). In most developing countries, shadow prices of labour are lower than the market prices, so social wages in the respective regions and the country as a whole were assumed to be 25% lower than the market wages obtained from the survey.

3.1.6 Other items

Housing depreciation and veterinary costs were very low, so the social and private prices were kept the same. About 99 and 80% of veterinary costs for poultry and pigs, respect- ively, were for drugs, which were sold at a competitive price without subsidy. Working capital in the private budget was valued at market prices and that in the social budget was valued at social prices. Thirty percent of the operating costs were taken as working capital on which a 10% interest was calculated. This was 1% higher than the base loan interest rate of commercial banks (World Bank 2000). The farm survey showed that farmers borrowed from commercial and agricultural banks at 0.6 to 1% per month for short term loans and 1 to 1.5% per month for medium term loans. Exotic poultry and pigs also require intensive care, extra feeding materials, electricity and other inputs (MARD 2000a). To account for these added costs, we included an

amount equivalent to 3% of the total costs. Private values of these costs are based on total costs of the private budget and social values are based on the total costs of the social budget.

3.2 Competitiveness in poultry production

3.2.1 Cost structure at market prices

For meat production, feed was the most important cost item accounting for 66–80% of total costs in the North and 58–63% in the South for different breeds (Table 5). Home supplied feeds were basically crude materials and some fodder crops. For local poultry, producers spent the largest share of costs on home produced feed in the North, but not in the South. Purchased feeds, principally concentrates, dominated the diet of crossbred and exotic breeds in both regions, and local breeds in the South. Labour, primarily family labour, was the other most important cost in both regions. In general, labour cost accounted for a higher share of total cost of local and crossbred poultry than for exotic poultry because smallholders primarily raised the former breeds using mainly family labour. Relative shares of veterinary costs were much higher for both crossbred and exotic chickens than the local breeds. The regional differences in the cost structure are wide. The production cost per tonne of local poultry meat in the North is more than double than that in the South, and the cost for crossbred poultry meat in the North is about four times higher than that in the South. On the contrary, the production cost of exotic poultry meat in the South is about 1.5 times higher than that in the North. The average input prices were higher in the South. For example, the average price of concen- trate feed was VND 4160/kg in the North but VND 4290/kg in the South.

Table 5. Cost structure (% of average total cost) of poultry meat production by breed in Vietnam,1999.

	North			South		
Cost items	Local	Crossbred	Exotic	Local	Crossbred	Exotic
Home-produced feed	66	3	0	5	1	0
Market feed	12	77	66	53	62	62
Parent stock	1	6	18	3	5	18
Labour	18	7	10	36	26	6
Veterinary and other costs	3	7	6	3	6	14
Total	100	100	100	100	100	100
Average total cost (VND* × 10^3/t)	16,876	11,334	5885	7228	2860	8765

* In 1999, US$ 1 = VND 14,008.
Source: IFPRI (2001).

For egg production, the cost distribution pattern of local breeds is very similar to that of meat production in both regions, but unit costs are much higher (Table 6). Share of labour in total cost of egg production is larger than that for meat production. Relative shares of veterinary costs and services are higher for crossbreds than for exotic chicken in the North but the share was highest for exotic chicken in the South. The reasons may be differences in the incidences of diseases and required attention, but detailed data on these were not collected.

Table 6. Cost structure (% of average total cost) of poultry egg production by breed in Vietnam, 1999.

	North			South		
Cost items	Local	Crossbred	Exotic	Local	Crossbred	Exotic
Home-produced feed	44	11	6	8	1	1
Market feed	23	60	55	59	54	54
Parent stock	1	4	21	2	7	23
Labour	29	17	10	28	34	7
Veterinary and other costs	3	8	8	3	4	15
Total	100	100	100	100	100	100
Average total cost (VND* × 10^3/t)	47,612	23,782	8427	38,625	10,828	5068

* In 1999, US$ 1 = VND 14,008.
Source: IFPRI (2001).

Although the difference between the price per tonne of meat and eggs is small, the cost difference is very large for local and crossbreds. Unit cost is much lower in the South for local and crossbred poultry for both meat and eggs (Tables 5 and 6). In particular, the cost of production of local breed meat and crossbred eggs in the North is more than double the cost in the South, while the cost of production of crossbred meat is about four times higher in the North. Thus, with the same breed, the producers in the South may be using inputs more efficiently and thereby reducing unit cost.

The diet of local breed poultry layers in the North consists principally of crude materials, especially home produced cassava (74%), while in the South, rice bran (66%) and maize (23%) are the main components of crude materials. Maize prices amount to about double the price of a root crop like cassava, but the edible energy in maize is about four times the energy in cassava (Scott et al. 2000). Thus, there is a possibility that the pro- ducers in the North are getting a lower yield due to the use of less energetic feed. For im- proved breeds, producers in both regions spent more on quality feed components such as soybean meal, fish meal and groundnut cake. Thus, it appears that producers in the North may be able to make local meat and crossbred egg production more profitable by adopting better feed management practices.

Average egg production per hen per year is generally found to be higher in the South than in the North, especially for crossbred and exotic breeds (Table 7). This is because the hens in the South are laying eggs for a longer period in a year, perhaps due to better nutrition. Also, the average age at laying is higher while average weight at

laying is lower in the North than in the South. This may also point towards the dietary differences ob- served between the two regions. High variability in egg production and length of laying period among breeds indicate that better management may lead to higher average pro- ductivity.

Table 7. Differences in the reproductive characteristics of layers, Vietnam, 1999.

	North		South	
Characteristics	Mean	CV (%)	Mean	CV (%)
Local layer				
Age at laying (weeks)	23.3	13.7	21.7	25.7
Weight at laying (kg)	1.4	11.1	1.5	17.2
Egg production (piece/hen per year)	68.1	36.1	72.7	42.2
Length of laying (months)	4.9	63.5	5.4	53.9
Crossbred layer				
Age at laying (weeks)	21.6	8.5	20.7	24.7
Weight at laying (kg)	1.6	10.4	1.8	15.5
Egg production (piece/hen per year)	99.1	36.2	137.4	33.6
Length of laying (months)	7.0	37.8	8.5	31.1
Exotic layer				
Age at laying (weeks)	21	18.2	18.6	24.8
Weight at laying (kg)	1.7	14.2	1.7	13.6
Egg production (piece/hen per year)	166.6	30.1	242.8	20.7
Length of laying (months)	9.3	22	11.2	15.1

Source: IFPRI (2001).

3.2.2 PAM results

All the enterprises were privately and socially profitable on a full cost basis except local breed meat and egg production and crossbred egg production in the North and local breed egg production in the South (Table 8). In general, private and social profitability were higher in the South than in the North and on an output per tonne basis, the profitability of meat production was greater than egg production except for exotic breeds in the South.

Profits can vary due to multifarious causes such as different intensity of input use, different prices of inputs and outputs etc. In the PAM framework, it is not possible to identify the relative contribution of such causes in profit variation. On average, both input and output prices were higher in the South with some exceptions such as the price of parent stock. Exotic egg prices were lower than local and crossbred egg prices in the North but the opposite was the case in the South. This may be partly due to regional differences in consumer preferences and partly also due to government policy. Data on the stock purchased from government sources showed that about 38% of the exotic stocks and none of the crossbred

Table 8. *Farm-level policy analysis matrix (VND* × 10^3/t), chicken, Vietnam, 1999.*

Breed and commodity	North				South			
	Revenues	Tradables	Factors	Profit	Revenues	Tradables	Factors	Profit
Local meat								
Private	15,274	5260	11,616	–1602	19,650	4337	2891	12,422
Social	10,910	5010	11,690	–5790	10,870	3679	2214	4977
Divergences	4364	250	–74	4188	8780	658	677	7445
Divergences (%)	40	4.98	–0.63	–72.34	80.77	17.88	30.59	149.59
Local egg								
Private	16,922	27,229	20,385	–30,693	14,109	25,888	12,739	–24,518
Social	12,082	26,580	17,346	–31,844	11,898	22,178	9827	–20,107
Divergences	4839	649	3040	1151	2211	3710	2912	–4411
Divergences (%)	40.05	2.44	17.53	–3.61	18.58	16.73	29.63	21.94
Crossbred meat								
Private	11,932	9955	1380	598	15,646	2009	851	12,785
Social	10,910	8313	1092	1506	10,870	1666	652	8552
Divergences	1022	1642	288	–908	4776	343	200	4233
Divergences (%)	9.37	19.75	26.37	–60.28	43.93	20.6	30.62	49.49
Crossbred egg								
Private	15,547	18,397	5387	–8237	14,043	6700	4128	3215
Social	12,799	15,853	4285	–7340	12,603	5599	3145	3858
Divergences	2748	2544	1102	–897	1440	1101	983	–644
Divergences (%)	21.47	16.05	25.71	12.22	11.43	19.67	31.25	–16.68
Exotic meat								
Private	11,949	4967	921	6062	11,671	7728	1039	2904
Social	10,910	4115	1168	5627	10,870	6448	824	3598
Divergences	1039	852	–247	434	801	1280	215	–694

cont'd...

Table 8. cont'd.

Breed and commodity	North				South			
	Revenues	Tradables	Factors	Profit	Revenues	Tradables	Factors	Profit
Divergences (%)	9.53	20.71	–21.18	7.72	7.37	19.85	26.09	–19.28
Exotic egg								
Private	10,875	6735	1692	2448	14,674	4326	742	9605
Social	10,875	5700	1292	3883	12,168	3684	599	7885
Divergences	0	1035	400	–1435	2505	642	143	1721
Divergences (%)	0	18.15	31	–36.96	20.59	17.43	23.81	21.82

* In 1999, US$ 1 = VND 14,008.
Source: IFPRI (2001).

stocks in the North were from government sources, while only 14% of the exotic stocks and more than 20% of the crossbred stocks were from government sources in the South. This indicates that government policy is more supportive towards the expansion of exotic breeds in the North but more supportive towards the expansion of crossbreds in the South.

Until 1999, the implementation of the policies directed towards liberalisation was extremely slow. Thus, the protective policy seems to be more conducive for the expansion of poultry production in the South as indicated by higher private profits than social profits. Social profits are higher for crossbred egg and exotic meat production. So, the policy seems less favourable for the adoption of high yielding exotic poultry for meat production in the South, but it was more supportive of exotic egg production. About 95% of eggs produced in the South came from exotic poultry compared to 65% in the North. Existing policy may be conducive to switching to the production of exotic egg particularly in the South, most probably by curtailing local and crossbred egg production.

Local breed meat production in the North, local breed egg production in both regions and crossbred egg production in the North are much less competitive than other op- tions. Producers in the North earn a subnormal rate of return in producing local breed meat, local breed egg and crossbred egg. For these enterprises, private and social returns are negative while the net effect of policy is positive except for crossbred meat. This in- dicates that net subsidisation of local breed poultry is not sufficient to make it privately profitable. The outcome differs between the North and the South. In the South, local and crossbred producers are in a better condition as they earn supernormal rates of return except for local egg production. Theoretically, we would expect farmers to exit from local breed poultry production (except for meat production in the South) and switch to activities where private returns are high, but the reality is different. Farmers apparently have non-efficiency objectives, e.g. use of family labour and household resi- dues as feed, for which opportunity cost is almost zero while there may be market niches for local breeds. The performance of local breed in the South is better than in the North because of the use of a higher proportion of concentrates, crude materials that have higher edible energy, and purchased feed materials.

All private prices for outputs are higher than import parity price except for exotic egg in the South that fall within the non-tradable area. This implies that the country would benefit more from import instead of producing chicken domestically as far as output prices are concerned. However, except for crossbred egg, world prices are higher than the cost of production for improved poultry production. This implies that Vietnam is in a position to export improved poultry meat at the existing world prices. On the other hand, the negative social profits for local meat and eggs in the North and local eggs in the South suggest that the country would be better off in terms of national growth by not producing them. Private profits for some enterprises in the South are markedly larger than social profits. This indicates a higher degree of imperfection in the market and scope for increasing production through the adoption of measures that can expand competition.

While producers are getting higher prices for their outputs, at the same time they are also paying prices for inputs that are higher than world prices. The reason for higher prices of tradable inputs is the price distortion resulting from the existing policy on import duties on feed items. The government does not provide any subsidy but levies import duties on tradable feed materials causing an increase in domestic prices. This policy creates a negative transfer as shown by the positive divergences between private and social values of tradables (Table 8). Since world prices of tradable inputs are lower than the domestic prices, the country would benefit more from importation of feed. Gener- ally, market failures and policy distortions are higher in the South, although they are also high for some production enterprises in the North. Thus, Vietnam may be an very good example of a country that could enter the world market by producing more output by using imported inputs in a liberalised market. What is likely to happen in reality requires further investigation, which is beyond the scope of this analysis.

The reasons for higher output prices in the domestic market may be due to greater demand growth in addition to a protective policy. However, sufficiently higher levels of private and social profits in the South and profits from exotic poultry meat in the North indicate that without any protection and even with a modest reduction in the demand growth, these enterprises would still remain competitive. If import levies from feed materials are withdrawn, there may be a possibility of switching from local to improved breeds. If so, large farmers may gain more as most of them generally adopt improved breeds.

Divergences are provided in relative terms for ease of comparison. Transport/handling costs are slightly lower in the South. Private prices are higher in the South for local and crossbred meat and exotic egg. In these cases, therefore, relative output divergences are higher. This implies that the producers here obtain a higher implicit subsidy due to market factors and a protective public policy. In the case of tradable inputs, relative di- vergences are higher for local and crossbred poultry in the South. That means implicit input taxes for local and crossbred poultry are higher in the South. Private profits are higher than social profits for the most profitable enterprises. Thus, producers gain from the existing policy and market factors.

3.2.3 Policy and comparative advantage indicators

The farm level PAM results were used to calculate policy and comparative advantage indi- cators (Table 9). Private prices for both outputs and inputs were higher than social prices in most of the cases. The private cost ratio (PCR) is a measure of private profitability. Among the 12 activities investigated, 9 are highly profitable and 3 are marginally profitable to the farmers as they were producing more value added products than domestic resource costs. However, local egg production failed to cover tradable input costs and therefore its PCR was negative in three out of six cases. The values of the domestic resource cost ratio (DRC) indicate that among the 12 activities, 8 including exotic poultry and some crossbred and local poultry have comparative advantages (DRC < 1). However, the country has a com- parative advantage in poultry production as a

whole if local egg is produced only for dom- estic consumption. In general, exotic breeds have comparative advantage over local and crossbred poultry production, and the South has a comparative advantage over the North. In fact, some activities in the South have very strong comparative advantages, indicating a lack of competition in the domestic market.

Table 9. Summary of comparative advantage indicators, chicken, Vietnam, 1999.

Commodity, breed, region	PCR[1]	DRC[2]	NPCO[3]	NPCI[4]	EPC[5]
Meat					
Local, North	1.16	1.98	1.40	1.05	1.70
Local, South	0.19	0.31	1.81	1.18	2.13
Crossbred, North	0.70	0.42	1.09	1.20	0.76
Crossbred, South	0.06	0.07	1.44	1.21	1.48
Exotic, North	0.13	0.17	1.10	1.21	1.03
Exotic, South	0.26	0.19	1.07	1.20	0.89
Egg					
Local, North	–1.98	–1.20	1.40	1.02	0.71
Local, South	–1.08	–0.96	1.19	1.17	1.15
Crossbred, North	–1.89	–1.40	1.21	1.16	0.93
Crossbred, South	0.56	0.45	1.11	1.20	1.05
Exotic, North	0.41	0.25	1.00	1.18	0.80
Exotic, South	0.07	0.07	1.21	1.17	1.22

1. PCR = Private-cost ratio.
2. DRC = Domestic resource cost ratio.
3. NPCO = Nominal protection coefficients for outputs.
4. NPCI = Nominal protection coefficients for inputs.
5. EPC = Effective protection coefficient.

Source: IFPRI (2001).

The values of nominal protection coefficients (NPCO and NPCI) show that the pro- ducers are protected for the output (NPCO > 1) at the expense of the tax they are paying for the inputs (NPCI > 1). The policy distortion and market conditions have resulted in the private price of output to be 40 and 80% higher in the North and the South, res- pectively, than what it would be under free trade. Thus, for local meat production, the implicit subsidy is much higher in the South. If the same levels of subsidy were provided in the North, local breed meat would be privately profitable. On the other hand, if the producers of local breed meat in the South were paid a subsidy at the level of the pro- ducers in the North, they would still earn high rates of profit. This would benefit more producers with the same amount of social cost.

Based on EPC values, producers of most of the enterprises, especially in the South, are rewarded by market conditions and policies (EPC > 1). In cases where producers are taxed more for the tradable inputs than outputs, there is a net tax on their value

added (EPC < 1), except in the case of local chicken egg in the North where the cost of pro- duction from tradable inputs was higher than output prices and therefore the value added was negative. Here, the EPC of 0.71 implies that more protection leads to a re- duced negative value added. Protection was generally lower for exotic poultry than for other breeds.

3.2.4 Sensitivity analysis

It is well known that PAM is a static model, which cannot capture the potential changes in policy parameters and productivity. The results of the analysis are subject to market conditions. To minimise this limitation, sensitivity analysis is conducted under alterna- tive scenarios. This study considered the following alternative scenarios for sensitivity:

1. social cost of labour was 1.23 times higher than the market price in the North and 1.23 times lower in the South[4]
2. social cost of labour was 50% (instead of 25%) lower than the market price
3. interest rate was 20% instead of 10%
4. import parity equivalent farm gate price for egg was VND 13,012,000/t in the North and VND 12,962,000/t in the South based on FOB Malaysia[5]
5. export parity equivalent farm gate price for poultry meat was VND 11,999,000/t in the North and VND 11,954,000/t in the South based on CIF Japan[6] and
6. exchange rate premium equals 10%.

The shadow price of labour is usually much lower than the market price in developing countries. However, in some growing economies, the difference is very low (Itty 1996; Yao 1997). Without further research, it is not possible to find out a more satisfactory price. With the changes in the wage rates under scenarios 1 and 2, we found that social profit changed but the relative competitiveness of different breeds of chicken remained the same. That means local meat and egg production in the North and local egg production in the South were still socially non-profitable. Local meat production in the South and exotic meat and egg production in both regions were still highly profitable, privately and socially. Similar results were obtained in the case of a rise in the interest rate (scenario 3). Greater changes were noticed when we allowed for changes in the social prices of output. For example, scenario 4 altered the DRC of crossbred egg production in the North from –1.4 to 0.98, and that of exotic chicken egg

4. This was based on the assumption that the social price was in between the higher average for the South and the mean price. We took the ratio of the average wage rate in the South and the average in the country and used this to calculate the social price by inflating the price in the North by the ratio and deflating the price in the South by the ratio.
5. Vietnam is a net exporter of eggs in shell (FAO 1999). Malaysia is the largest exporter in Asia. So, in this scenario import parity price was calculated based on FOB Malaysia.
6. Japan imports 34% of Asian and 12% of world poultry meat.

in the North from 0.41 to 0.11. Local egg production was still not socially profitable. Scenario 5 made a large change in DRC for local chicken meat in the North from 1.98 to 1.3, but still failed to alter comparative advantage. Exotic egg and meat production are highly profitable, both in the South and in the North. They are also highly competitive in the world market. The sensitivity analysis indicated that with a moderate dumping in the world market or changes in the government policy instruments such as interest rates, import duties, tax and subsidy, exotic poultry (both for meat and egg production) would still be competi- tive.

3.3 Competitiveness in pig production

3.3.1 Cost structure at market prices

Distribution of costs per tonne by region and breed is shown in Table 10. All prices of outputs and inputs were weighted and averages calculated from the survey data. The survey recorded the number of animal sales and change in inventories for different categories of pig, e.g. adult fattening pig, sow, boar, fattening pig of less than 50 kg live weight, piglets, gilt and immature boar. We converted farm-specific number of animals into live weights by giving appropriate weights obtained from the survey. Among the sample farms, 41% of the pig sales (including change in inventories) were adult fattening pigs, 37% were fattening pig of less than 50 kg, 22% were piglets, gilt and immature boars, and about 1% were sows and boars. Adult fattening pig weight per head was 70 kg for local, 80 kg for crossbred and 94 kg for exotic breeds.[7] Live weights of reproductive sows and boars were based on their average mature weight. Adult reproductive sows had average live weights of 95 kg for local, 110 kg for crossbred and 130 kg for exotic breeds. Adult boars had average live weights of 116 kg for local, 150 kg for crossbred and 162 kg for exotic breeds. The actual live weights for fattening pigs less than 50 kg, piglets, gilt and immature boars were not available so they were calculated using the price ratio with adult fattening pigs. The weights for these categories varied from 38 to 40 kg for local, 43 to 45 kg for crossbred and 46 to 49 kg for exotic breeds.

Table 10. Cost structure (% of average total cost) of pig production by breed in Vietnam, 1999.

	North			South		
Cost items	Local	Crossbred	Exotic	Local	Crossbred	Exotic
Home-produced feed	11	13	2	6	22	20

7. It was assumed that all producers sold animals of a particular category having the same live weight, e.g. adult fattening pigs (local) have 70 kg live weight for all farms. In fact, size and therefore live weight may vary within a particular category. As the averages are used in the PAM analysis, such variations presumably will not make a significant difference in the result.

Market purchased feed	31	44	58	38	41	40
Parent stock	42	31	28	27	24	28
Labour	10	6	5	24	7	4
Veterinary and other costs	6	6	7	5	6	8
Total	100	100	100	100	100	100
Average total cost (VND* $\times 10^3$/t)	6390	5882	10,043	8756	11,309	9513

* In 1999, US$ 1 = VND 14,008.
Source: IFPRI (2001).

The components of home-produced and purchased feed are various types of crude materials, fodder crops and concentrates. Crude materials contain broken rice, rice bran, maize, cakes and meals, roots and tubers and other materials. Feed, especially purchased
feed, generally occupied the highest share of cost followed by parent stock and home-produced feed and labour. The cost share of purchased feed was the highest for improved breeds while the share of labour was highest for local breeds in both regions. Prices of parent stocks were usually higher in the South, particularly for improved breeds. The dif- ference in the cost distribution may arise due to divergences in input management, input prices, output prices and productivity. Output and some feed prices were higher in the South but some feed prices were slightly lower. For example, maize prices were lower in the South but prices of fodder crops were higher.

Per unit cost was lowest for crossbred pigs in the North but highest for the same breed in the South (Table 10). The reason for this is unclear but the analysis of cost com- ponents indicates that the difference may result from differences in the use of concent- rate feed, which is the most costly item. On the other hand, concentrate feed, being of high quality, may improve productivity and hence reduce per unit cost. Also, higher prices of parent stocks may be another reason for higher per unit costs, but these did not appear to be true for all cases. The proportionate spending on parent stocks was not high for crossbreds compared to other breeds in the South.

Crude materials, both from home and the market constitute the highest proportion of feed cost for local and crossbred pig. Rice, paddy, rice bran and maize are the main components of crude materials (Table 11). Producers in the North spend relatively more on low cost waste materials, while producers in the South spend more on higher priced cakes and meals. This may be another reason for the higher cost of production for cross- breds in the South.[8]

8. A recent partial equilibrium model for the Vietnam agricultural sector found that improvements in breeding, marketing, and animal health have the strongest effects on aggregate income, and elimination of tariff and improvements in the productivity of feed crops barely affect income (IFPRI 2001). The present analysis indicates that the negligible effects of feed crops found in the partial equilibrium model framework may be due to the existing level of inefficiency in the use of feeds. Feed cost ratio (cost per kg of weight gains) is higher for exotic breeds. This can be improved through better feed management practices learned through training and extension services. Feed and stock are, in fact, the most dominant cost components in the production of pig and poultry.

Table 11. The composition of crude material costs in the pig diet by breed, Vietnam, 1999.

Type of crude materials	North local (%)	North improved (%)	South local (%)	South improved (%)
Broken rice, paddy, rice bran	43.1	48.9	60.2	44.9
Maize	12.0	17.7	32.6	26.3
Roots and tubers	4.4	3.2	1.5	4.2
Brewer's waste	2.4	3.8	1.9	2.5
Cakes and meals	1.7	4.3	0.6	9.7
Others	36.4	22.1	3.1	12.4
Total	100.0	100.0	100.0	100.0

Source: IFPRI (2001).

Overall, 69% of farms adopted improved breeds, 18% adopted exotic breeds and 51% kept crossbreds. In the South, 48% of the sample producers adopted exotic pig compared to 3.5% in the North, while 43% in the South and 54% in the North, respectively, adopted crossbred pig. Low adoption of exotic breeds in the North may arise from the relatively lower productivity of such breeds in that region, which makes the per unit cost of production relatively high, and so that there is less incentive for farmers to raise these particular breeds. The reason for the lower productivity of exotic breeds in the North is unclear.

3.3.2 PAM results

At market prices, all breeds are profitable except for exotic breeds in the North (Table 12). Private profit is the highest for exotic breeds in the South, followed by crossbred and local breeds in the North. In general, pig production is competitive from a financial point of view.

Table 12. Farm-level policy analysis matrix (VND* $\times 10^3$/t live weight), pig, Vietnam, 1999.

	North				South			
	Local	Cross-bred	Exotic	All	Local	Cross-bred	Exotic	All
Private values								
Revenue	8425	8057	9655	8269	10,063	11,499	13,747	12,470
Tradables	5156	4894	8835	5644	5565	9442	8637	8400
Factors	1234	988	1208	1086	3191	1867	971	1114
Profit	2035	2175	–388	1539	1307	189	4139	2956
Social values								
Revenue	8710	8710	9655	8810	9890	9890	9890	9890
Tradables	4324	4139	7290	4707	5121	8020	7256	7187
Factors	1016	838	979	903	2602	1542	795	951

Profit	3370	3733	1386	3200	2168	328	1838	1752
Divergences								
Revenue	–285	–653	0	-541	173	1609	3857	2580
Tradables	832	755	1545	937	444	1422	1381	1212
Factors	218	150	228	183	589	326	175	163
Profit	–1335	–1557	–1774	–1662	–860	–139	2301	1205
Divergences (%)								
Revenue	–3.27	–7.50	0	–6.14	1.75	16.27	39	26.08
Tradables	19.24	18.23	21.2	19.92	8.67	17.73	19.03	16.87
Factors	21.49	17.86	23.33	20.3	22.64	21.12	22.04	17.09
Profit	–39.62	–41.73	–127.98	–51.92	–39.69	–42.36	125.17	68.77

* In 1999, US$ 1 = VND 14,008.
Source: IFPRI (2001).

The analysis of tradable inputs reveals that producers are paying higher than the social price. In relative terms, the difference ranges from about 8.7% for local breeds in the South to 21% for exotic breeds in the North. Thus, the producers in the North are paying taxes both for output and input. In particular, higher implicit taxes on inputs preclude producers of exotic breeds in the North from making profits. Social profits are generally higher than private profits but producers are not protected except for exotic breeds in the South. Market conditions are such that domestic consumers in the South are paying high prices, implying the existence of an implicit subsidy in the production of exotic breeds in the South. The producers in the North are not protected for any of the breeds. The consumers in the North are paying lower than the international price. The social profits are all positive, suggesting that the country is competitive in pig production. The country as a whole is not subsidising the industry. The government's policy on tariffs on feed imports and output prices are favourable for the adoption of exotic pig in the South, but not in the North. Although the domestic market in the North fails to offer the social price to the producers, yet the production of local and crossbred pig is privately profitable.

3.3.3 Comparative advantage indicators

The private profitability is high for all breeds (PCR < 1), except for exotic pigs in the North. Return to factors is the highest for exotic breeds in the South (Table 13). Thus, the same breed is performing differently in the two regions. The feed conversion rate for exotic breeds was higher in the North, indicating that the market prices and tariff policy are responsible for private losses from exotic breeds. Import tariff on feed items make feed prices higher, but the output price is lower than the international price. The per- formance of local pigs in the South was poor because of lower feed conversion and sur- vival rates. However, the differences in these characteristics are negligible for crossbreds.

Table 13. Summary of comparative advantage indicators for pig production, Vietnam, 1999.

	North				South				
Ratio indicators	Local	Crossbred	Exotic	All	Local	Crossbred	Exotic	All	All regions
PCR[1]	0.38	0.31	1.47	0.41	0.71	0.91	0.19	0.27	0.6
DRC[2]	0.23	0.18	0.41	0.22	0.55	0.82	0.3	0.35	0.32
NPCO[3]	0.97	0.93	1.0	0.94	1.02	1.16	1.39	1.26	1.0
NPCI[4]	1.19	1.18	1.21	1.2	1.09	1.18	1.19	1.17	1.18
EPC[5]	0.75	0.69	0.35	0.64	0.94	1.1	1.94	1.51	0.61

1. PCR = Private-cost ratio.
2. DRC = Domestic resource cost ratio.
3. NPCO = Nominal protection coefficients for outputs.
4. NPCI = Nominal protection coefficients for inputs.
5. EPC = Effective protection coefficient.

Source: IFPRI (2001).

Under existing technologies and market conditions, both regions show strong comparative advantage in pig production (DRC < 1). The North has more comparative advantage in local and crossbreds and the South in exotic breeds. Thus, existing government policy is supportive of expanded production but the North and the South are deriving benefits through different breeds and in disproportionate terms. The producers in the South are benefiting more from exotic breeds, which are more productive than the local and the crossbreds.

Examination of DRC by size indicated that in most cases, the DRC for smallholders was higher than that for medium and large farms; but in all cases, it was less than one. Thus, smallholders were less competitive but they still had comparative advantage given existing cost and price structures in the international scene.

The values of nominal protection coefficients reveal that producers in the South are protected by policy and market conditions for output (NPCO > 1) but producers in the North are not (Table 13). In general, producers in the North are taxed more than the producers in the South (NPCI > 1 and higher in the North except for crossbred). The policy distortion and market condition have permitted the private price of exotic pig in the South to be 39% higher. Producers of exotic pig in the North would have made a profit if output prices were the same as in the South. On the whole, the implicit subsidy due to tariff policy and market prices is much higher in the South than in the North.

3.3.4 Sensitivity analysis

We considered the same alternative scenarios as in section 3.2.4 for chicken except scen- arios 4 and 5, which are not applicable for pigs. Under scenario 1, the social cost of labour became higher and therefore DRC became slightly higher in all cases, but the relative positions remained unchanged. For example, in the North, DRC increased to 0.22 from 0.19. With respect to scenario 2, with higher interest rates, DRC became

slightly lower than the baseline scenario, but the relative position remains the same. In this case, however, the private profits for crossbred pig in the South became negative as DRC increased to 0.69 from 0.59, yet it retained its comparative advantage. With a 10% rise in the equilibrium exchange rate premium, border prices of both inputs and outputs increased but relative comparative advantage measured by DRC remained unchanged because most of the cost items were tradable.

3.4 Summary

Both the poultry and pig production sectors have strong comparative advantage with some exceptions. Poultry production is generally competitive with the exception of meat and egg production with local breeds, and egg production with crossbreds in the North, and egg production with local breeds in the South. Productivity is low in these activities and therefore per unit cost is high, thus making them less competitive. Domestic prices of both outputs and inputs are higher than world prices. If output prices fall moderately due to the withdrawal of protective policies and if domestic demand slows down from the current high levels, the breeds that are profitable under the existing situation would still remain competitive. Exotic breeds in the South, both for meat and egg production, would still be competitive with changes in government policy instruments such as interest rate, import duties, tax and subsidy, with a moderate fall in output prices and a moder- ate rise in feed prices in the world market. The domestic demand is actually increasing due to the continuing income growth and urbanisation, so even socially unprofitable enterprises may continue to be produced for local consumption to a limited extent de- pending on consumer preference.

Differences in technical performance of different poultry breeds between the two regions indicate that exchanging and sharing technical and management knowledge across the regions can improve the overall productivity of these breeds. The North can benefit by acquiring knowledge with respect to exotic breeds, while the South may benefit by acquiring knowledge with respect to local and crossbreds. Extension, training and information dissemination programmes with further support through credit and better access to secondary markets will improve technical efficiency. Contract farming may also provide some opportunity for smallholders to stay in business if large-scale operations dominate the industry over time.

Pig production under existing technologies and market conditions is highly competitive, especially with local and crossbreds in the North and exotic breeds in the South. Pig prices are less distorted than chicken. With a relatively low level of protection, private profitability is sufficiently high, except for exotic breeds in the North. Profitability is the highest for exotic breeds in the South. Although the existing tariff policy and market prices are supportive of expanded production throughout the country, the producers in the South are apparently benefiting more. Performance of the same breed differs between regions, indicating the potential for improvement through changes in the market con- ditions (input and output prices), tax and tariff policies and

input management, especially feed, through better extension and information dissemination. The performance of local pigs in the South may be improved through better feed-conversion and survival rates, which are lower compared to the North. Producers of exotic pigs in the North incur losses in spite of higher feed conversion rate because the import tariff on feed items make feed prices higher than the international prices, while output prices remain low. Thus, exotic pig producers in the North are paying for policy and market induced dis- tortions. Under a more liberalised policy regime, pig production may expand further in Vietnam.

Available information did not permit the inclusion of costs or benefits of environmental externalities created by poultry and pig production enterprises. It was observed during the survey that smaller pig and poultry farmers were effectively recycling manure through crop and vegetable production, and some larger production units were selling manure but most had difficulty in appropriately disposing the wastes and were perhaps creating environmental pollution (water contamination, public health problem). It is not clear if the level of competitiveness would significantly change or if there would be scale effects if these differential externalities were accounted for.[9]

The PAM results are based on the performance of the average farm. In reality, differ- ences in technical and economic efficiency may be much wider across individual farms and this may also vary for different breeds. Thus, at the individual farm level, the ability to compete within a liberalised economic environment may vary widely, where some may be highly competitive while others may not be so. A detailed farm-specific efficiency analysis may therefore shed more light on the production frontiers of poultry and pig farms in the country. This is dealt with in the next section.

9. Estimates of environmental costs and subsidies in developing countries are scanty. In a Mexican case study on pig production, an estimate of the treatment costs avoided was used to estimate the magnitude of the subsidy, as it was not possible to directly value damage from the environmental pollution. The results showed that additional subsidies could be considered to have taken place through subsidised transport infrastructure, fuel and the non-enforcement of environmental legislation. With regard to the latter, since adequate treatment systems generally run to about 3–5% of production costs, the lack of enforcement leads to an effective 'natural resource degradation' subsidy of approximately US$ 37 million per year (or US$ 3.3 per head). A 'back of the envelope' calculation of the total value of these subsides (environmental and fiscal) suggested a value of at least US$ 17 per head, which was similar to Canadian subsidies to pig farmers (Drucker et al. 1999).

4 Farm specific efficiency in poultry and pig production

4.1 Analytical framework

The stochastic frontier production function approach was used for measuring technical efficiency in this study. There are two basic empirical approaches to the measurement of production efficiency using the frontier methodology: mathematical programming techniques of estimating a frontier relationship usually termed Data Envelopment Analysis (DEA) and econometric techniques that are either deterministic or stochastic. Following the pioneering work of Farrell (1957), the theoretical and applied research in this area has become rich (Aigner and Chu 1968; Seitz 1970; Bardhan 1973; Aigner et al. 1977; Charnes et al. 1978; Forsound et al. 1980; Russell and Young 1983; Kalirajan 1990; Battese and Coelli 1992; Bravo-Ureta and Pinheiro 1993; Kumbhakar and Lovell 2000).

The stochastic frontier approach incorporates a composed error structure with a one-sided inefficiency component and a two-sided symmetric random component (Aigner et al. 1977; Meeusen and van den Broeck 1977; Jondrow et al. 1982; Battese and Coelli 1988; Greene 1992). The inefficiency component is used to obtain firm specific or average ef- ficiency and the random component picks up the effect of uncontrolled random shocks, such as weather, measurement error, disease and other statistical noise. By contrast, the DEA and deterministic models assume any deviation from the frontier is due to inef- ficiency and consequently they do not allow for random shocks, which is unrealistic. Random error may not be zero even if a farm uses a best practice technique due to errors of measurement, weather and other factors.

This study uses the stochastic frontier approach in which there are many variants in model specification and distribution of the unknown variance of the efficiency component. We assume a modified Cobb-Douglas specification and specify the following frontier production and inefficiency models that are variants of Coelli and Battese (1996):

$$\ln(Y_{ip}) = \alpha_{0p} + \Sigma\beta_{jp}\ln(X_{ijp}) + \Sigma\alpha_{jp}D_{jp} + v_{ip} - u_{ip} \quad (1)$$

$$\mu_{ip} = \delta_{0p} + \Sigma\delta_{kp}Z_{ikp} \quad (2)$$

where the subscripts i, j, k and p refer to the i-th farmer, the jth and the kth parameter or variable and pth activity, respectively, (i = 1…n, j = 1…J, k = 1…k, p = 1 for poultry production and 2 for pig production); ln represents the natural logarithm; Y, X and Z are variables to be defined below.

The α_{0p}, β_{jp}, α_{0p} and α_{kp} are unknown parameters to be estimated; the $v_{ip}s$ are assumed to be independently and identically distributed random errors with distribution $N(0, \sigma_v^2)$; the $u_{ip}s$ are non-negative technical inefficiency effects independently distributed and arise by truncation at zero of the normal distribution $N(\mu_{ip}, \sigma_u^2)$, where the unknown variance σ_u^2 is defined by:

$$\sigma^2 = \sigma_u^2 + \sigma_v^2 \qquad (3)$$

$$\gamma = \sigma_u^2 / \sigma^2 \qquad (4)$$

and the mean μ_{ip} is defined by equation (5) below.[10] The value of the parameter γ lies be- tween zero and one. It was mentioned earlier that when the frontier production function is defined for the logarithm of production, the suggested measure of technical efficiency for the ith farm is then:

$$TE = \exp(-\mu_{ip}) \qquad (5)$$

Thus, given the specification of the stochastic frontier models (1) and (2), the technical efficiency of the ith farm can be obtained using equation (5) (Battese and Coelli 1993).

In addition to measuring the level of efficiency, differences in efficiency levels and their causes have also been explained. Empirical studies to explain efficiency of farmers used either a two-stage or a single-stage approach. In the two-stage approach, the first stage in- volves the estimation of a stochastic frontier function and the prediction of farm specific technical inefficiency or efficiency effects. The second stage estimates the effects of the fac- tors explaining technical efficiency using ordinary least squares regression. This approach is criticised on the ground that the assumption of independent and identical distribution of the inefficiency effects is violated in the second stage when they are made to be a function of the farm specific factors (Kumbhakar et al. 1991; Reifschneider and Stevenson 1991). The single-stage approach specifies stochastic frontiers and models for the technical inefficiency effects and simultaneously estimates all the parameters involved. We apply this one-stage approach because it leads to more efficient inference with respect to the par- ameters involved (Coelli and Battese 1996). The Frontier 4.1 software was used to estimate parameters (Coelli 1994).

4.2 Variables for empirical models

The variables used for equations (1) and (2) are described in Table 14. The X variables are in the production function and the Z variables are in the inefficiency function. Most im- portant inputs in poultry and pig production are breeding and young stocks, labour and feed. The feed inputs consist of various crude materials and fodder crops (purchased from the market and produced on farm) and concentrate feed. Crude materials and fodder crops are of lower quality than concentrates. In order to capture the effects of feed quality on production performance, the ratio of crude materials and fodder crops to total feeds is used as a separate variable.

10. Coelli and Battese (1996) used this formulation for a time variant model and used the notation μ_{it} instead of μ_{ip}. Here we use cross-section data and therefore modify the formulation as required.

Table 14. Description of variables included in the stochastic frontier function for chicken and pig production, Vietnam, 1999.

Variable	Description of the variable
Output (Y)	Value of output plus change in inventories (VND × 10^3 per farm)
Stock (X1	Value of stocks in VND × 10^3 per farm
Labour use (X2)	Annual labour (person days) spent for production
Feed (X3	Total feed (kg per household)
Crude feed ratio (X4	Ratio of crude materials and fodder crops to total feed
Housing (X5	Housing area (m^2 per household)
Veterinary cost (X6	Annual cost on veterinary fees and drugs (VND × 10^3 per farm)
Farm type (D1)	Dummy for business type: 1 = commercial farm, 0 = family farm
Crossbreed (D2)	Dummy for breed: 1 for crossbred, 0 otherwise*
Exotic breed (D3)	Dummy for breed: 1 for exotic breed, 0 otherwise*
Mixed breeds (D4)	Dummy for breed: 1 for mixed breeds, 0 otherwise*
Enterprise mix (D5)	Dummy for mixes of livestock types: 1 = pig and/or poultry and other livestock, 0 = only poultry or pig
North-East region (D6)	Regional dummy, 1 for North-East**
North-West region (D7)	Regional dummy, 1 for North-West**
North Central Coast (D8)	Regional dummy, 1 for North Central Coast**
Central Highlands (D9)	Regional dummy, 1 for Central Highlands**
North-East South (D10)	Regional dummy, 1 for North-East South**
Mekong River delta (D11)	Regional dummy, 1 for Mekong River Delta**
Producers' age (Z1)	Age of the producer (years)
Labour supply (Z2)	Number of adult persons available for farm work
Land size (Z3)	Total cultivated land (hectare per household)
Flock/herd size (Z4)	Number of birds/animals in the entire flock/herd
Credit use (Z5)	Dummy for credit: Received credit for poultry/pig production = 1, 0 if not
Education (Z6)	Highest level of education of household (hh) head
Gender (Z7)	Dummy for gender of the hh head: 1 = female, 0 otherwise
Market access (Z8)	Distance in km (longer distance indicating access to secondary markets)
Sale at market place (Z9)	Percentage of product sold at the market place rather than at farm gate
Contract sale (Z10)	Percentage of product sold through contract
Government inputs (Z11)	Percentage of veterinary inputs and stocks received from government enterprises, department of agriculture and co-operatives
Visits by government service providers (Z12)	Number of visits (inspections) by the providers of services by government and quasi government organisations and co-operatives
Home-produced crude material (Z13)	Ratio of home produced crude materials and fodder crops to total crude materials and fodder crops

In 1999, US$ 1 = VND 14,008.
* The base is the producer having local breed.
** The base zone in the North region is the Red River Delta and that in the South is the South Central Coast.

The dummy variables for farm types are of particular interest. Commercial farms are expected to be on the higher production frontier than the household farms. Farms pro-

ducing improved breeds are expected to be on the higher production frontier than those producing local breeds for both poultry and pig production. The producers who are specialised in poultry or pig production alone are expected to be on the higher production frontier than the producers who simultaneously produce a number of different types of livestock. The agro-climatic variations may affect productivity and these are cap- tured by the agro-ecological regional dummy variables.

The variables explaining inefficiency include household characteristics, scale factors and access to resources such as credit, market, assets, information and services. However, the expected signs of the parameters in the inefficiency model, defined by equation (2) cannot be predicted a priori in all cases.

Some hypotheses related to the factors influencing efficiency are as follows. Access to credit for poultry/pig production may increase the ability to use better quality inputs and services, hence increasing efficiency. Higher levels of formal education and training are expected to increase efficiency. Female-headed farms may be less efficient due to less education, training and lower access to information. Access to secondary markets for outputs and inputs may increase efficiency by allowing getting favourable prices com- pared to local markets. Although total transaction costs could be higher to access second- ary markets, unit transaction cost may be lower and the price differences with local mar- kets may more than compensate the higher costs (Akter and Islam 1986). Contract sale may reduce inefficiency by reducing transaction costs and market uncertainty but it can also increase inefficiency that arises from lack of flexibility to take advantage of better market conditions. The supply of inputs from government sources is expected to reduce inefficiency if quality is better and farmers get them in time at a lower price than other sources. The outcome may be the opposite if the quality is poor and the inputs and services are not supplied at the optimal time. The existence of other sources of income implies greater access to assets and liquidity. Higher non-agricultural income therefore may contribute to reduced inefficiency. It may also increase inefficiency if less attention is given to farming due to less dependency on farm income. Access to information and extension and veterinary services, and frequent visits by government organisations and co-operatives are expected to reduce inefficiency, because such services are expected to promote the adoption of new technology and improve technical knowledge of the pro- ducers. Home produced feeds (crude materials and fodder crops) are likely to be of poorer quality than those bought from the market, so a higher share of home produced feed used may increase inefficiency.

4.3 Efficiency in poultry production

4.3.1 Poultry production behaviour and inefficiency effects

The maximum-likelihood estimates for the parameters in the stochastic frontier and inefficiency equations for the producers in the North and in the South are presented in Tables 15 and 16, respectively. The values of the ^{2}, , log likelihood function and test statistic and their significance levels indicate that inefficiency effects of a stochastic

nature exist in both regions but at a higher degree in the North. The estimated coefficients of the input variables of the frontier production function are all positive as would be expected. All are significant at the 1% level. The elasticity for all inputs are small and their sum equals significantly less than unity indicating decreasing returns to scale in both regions.

Table 15. Maximum likelihood estimates for parameters of the stochastic frontier and inefficiency models, chicken sector, North Vietnam, 1999.

Production factors	Coefficients	Inefficiency factors	Coefficients
Constant	5.512*** (0.248)	Constant	0.218 (0.486)
Stock (ln X1)	0.103*** (0.013)	Producer age (Z1)	0.004 (0.005)
Labour (ln X2)	0.108*** (0.023)	Labour supply (Z2)	–0.097** (0.057)
Feed (ln X3)	0.425*** (0.019)	Land size (Z3)	–0.210*** (0.024)
Crude feed ratio (ln X4)	–0.013*** (0.004)	Flock size (Z4)	–0.0001***(0.0004)
Housing (ln X5)	0.121*** (0.022)	Credit use (Z5)	–2.421*** (0.618)
Veterinary cost (ln X6)	0.026*** (0.009)	Education of household head (Z6)	–0.111** (0.067)
Farm type (D1)	0.292*** (0.039)	Gender of hh head (Z7)	0.260*** (0.112)
Crossbred (D2)	0.225*** (0.095)	Market access (Z8)	–0.059* (0.047)
Exotic breed (D3)	0.527*** (0.067)	Sale at market place (Z9)	–0.002*** (0.001)
Mixed breed (D4)	0.371*** (0.082)	Contract sale (Z10)	–0.026*** (0.005)
Enterprise mix (D5)	–0.139*** (0.062)	Inputs from government (Z11)	0.001 (0.001)
North-East (D6)	–0.031 (0.042)	Visits by government service providers (Z12)	–0.097* (0.061)
North-West (D7)	0.087* (0.057)	Home produced crude material (Z13)	0.143 (0.129)
North Central (D8)	–0.089** (0.051)		

Variance ($=\sigma^2$) = 0.388*** (0.041); $\gamma = \sigma^2_u / \sigma^2$ = 0.669*** (0.047).
Log-likelihood function = –467.20; Test statistic λ (df = 15)[1] = 84.59***.
***, ** and * show statistical significance at the 1, 5 and 10% levels, respectively. Figures in parentheses are standard errors.
1. Log-likelihood ratio test for the null hypothesis that the inefficiency effects are not present, H_0: $\gamma = \delta_0 \ldots \delta_{16} = 0$. Test statistic $\lambda = -2 \ln [L(\omega)/L(\Omega)]$, where $L(\omega)$ and $L(\Omega)$ are the values of the likelihood function under the null and alternative hypotheses H_0 and H_1, respectively. This statistic has a mixed χ^2 distribution (Coelli 1994).
Source: IFPRI (2001).

The coefficient of the ratio of crude materials and fodder crops to total feed is negative and significant in both regions, indicating that the marginal productivity of crude materials and fodder crops is significantly lower than the concentrate feed. Thus, it appears that the mix of feed strongly influences chicken production.

The coefficient of farm type dummy (D1) is positive and significant in the North indi- cating that commercial farms in that region are more productive than household farms. The coefficients of dummies representing different improved breed poultry production indicate that the improved breeds, especially exotic breeds, are more productive than local breeds in both regions. Specialised poultry producers are more productive than farms having a mixture of livestock enterprises in both regions,

perhaps because special- ised producers pay attention to a single enterprise rather than distributing efforts to several matters.

Table 16. Maximum likelihood estimates for parameters of the stochastic frontier and inefficiency models, chicken sector, South Vietnam, 1999.

Production factors	Coefficients	Inefficiency factors	Coefficients
Constant	4.295*** (0.425)	Constant	0.175 (0.967)
Stock (ln X1)	0.042*** (0.014)	Producer age (Z1)	–0.061*** (0.022)
Labour use (ln X2)	0.191*** (0.052)	Labour supply (Z2)	0.208 (0.178)
Feed (ln X3)	0.597*** (0.041)	Land size (Z3)	–0.003 (0.382)
Crude feed ratio (ln X4)	–0.009** (0.005)	Flock size (Z4)	–0.0001***(0.0004)
Housing (ln X5)	0.067** (0.038)	Credit use (Z5)	1.187** (0.672)
Veterinary cost (ln X6)	0.021* (0.015)	Education of household (hh) head (Z6)	–0.102 (0.119)
Farm type (D1)	–0.062 (0.100)	Gender of hh head (Z7)	–0.801 (0.941)
Crossbred (D2)	0.127 (0.141)	Market access (Z8)	–0.091*** (0.014)
Exotic breed (D3)	0.547*** (0.131)	Sale at market place (Z9)	0.009*** (0.004)
Mixed breed (D4)	0.360** (0.198)	Contract sale (Z10)	–0.011 (0.013)
Enterprise mix (D5)	–0.146** (0.090)	Government inputs (Z11)	0.013*** (0.004)
Central Highlands (D9)	–0.146* (0.094)	Visits by government service providers (Z12)	0.035 (0.097)
North-East South (D10)	–0.117 (0.116)	Home produced crude feed (Z13)	1.086*** (0.532)
Mekong Delta (D11)	–0.011 (0.110)		

Variance ($=\sigma^2$) = 1.442*** (0.210); $\sigma^2_u/\sigma^2 = \gamma$ = 0.897*** (0.025).
Log-likelihood function = –214.75; Test statistic λ (df = 15)[1] = 82.50***.
***, ** and * show statistical significance at the 1, 5 and 10% levels, respectively. Figures in parentheses are standard errors.
1. A note on this test is provided in Table 15.
Source: IFPRI (2001).

In comparison with the Red River Delta region, productivity is higher in the North-West but lower in the North Central Coast in the North. In the South, only the Central Highlands is less productive compared to the South Central coast.

Among the 13 inefficiency factors, 10 are significant at the 10% level or less in the North, and 7 in the South. However, the set of significant factors and the direction of influence of a specific factor is not always the same in the two regions. Larger flock size (Z4) significantly reduced inefficiency in both regions. Larger flock size generally helped derive economies of scale in input purchases and output sales. About 96% of local and 68% of crossbred poultry producers were smallholders, and they generally were less efficient. However, 28% of exotic poultry producers were small in both regions, about 39 and 34% were medium in the North and the South, respectively, and the remainders were large-scale producers. Analysis of cost per unit of output for exotic poultry showed that scale economies exist in the North but not so clearly in the South (Table 17). This is mainly because of the economy in feed purchases that occupy the largest share in the total cost. In the North, medium producers spend more on home made feed, veterinary

medicine and service, and parent stock purchase but economise on labour and purchased feed. In the South, the diseconomy of the large farmers may have resulted from higher cost of concentrate feed, veterinary cost and parent stock purchase, though labour cost was lower. Moreover, the diseconomy may have resulted from the inefficient use of the quantity of feed and parent stock, not from prices. The feed prices were the same for all groups and the large farmers in the South bought parent stocks at lower unit prices than the small and medium producers because they could reduce transactions cost for a larger volume of business. This implies that the use and composition of feed is very important to derive economies of scale in production. The medium farms in the South are most efficient. Under the rapid expansion of liberalisation policy, there is a possi- bility for these farms to grow bigger with cheaper feed in the open market; but if current trends continue, they may become less efficient with size.

Table 17. Farm-level input costs for production of exotic chicken meat by flock size, Vietnam, 1999.

	North			South		
Description of inputs	Small	Medium	Large	Small	Medium	Large
Total cost (VND × 10^3/t)	12,789	10,084	5124	9518	8011	8594
Feeds as % of total cost	58	63	65	63	78	61
Labour as % of total cost	31	14	8	25	9	4

Source: IFPRI (2001).

Longer distance to nearest market (Z8), which indicates access to secondary markets, significantly reduced inefficiency, as unit output price generally received was higher and unit input price paid was lower. Moreover, higher transactions costs for accessing sec- ondary markets were most likely more than compensated by the price differences with the local markets. In the South, farms with older household heads had significantly lower inefficiency, but age had no significant effect in the North. More members in the family available for farm work (Z2) and larger land holdings (Z3) significantly reduced in- efficiency in the North, but neither had significant effects in the South. Larger cultivated land within the context of severe land scarcity in the North may give greater incentive to farmers for putting more family labour in agricultural operations including poultry pro- duction due to their higher degree of dependence on agriculture. Also, larger land size may generate adequate cash income to make complementary investment in poultry. Access to credit (Z5) significantly reduced inefficiency in the North but significantly in- creased inefficiency in the South. Normally, access to credit is expected to leverage cash constraints and allow the purchase of better quality inputs and services, leading to in- creased productivity and efficiency. Therefore, the opposite result in the two regions may be due to the purpose for which the credit was used; but details on this could not be ascertained from the field data. For example, credit for stock purchases might not reduce inefficiency if adequate feeds and veterinary inputs were not provided.

Better education of the household head (Z6) significantly reduced inefficiency in the North perhaps because education facilitates better information gathering and application, but education had no significant effect in the South. Female-headed households (Z7) were significantly less efficient in the North, but sex of household head had no significant effect in the South. Female-headed households were generally less educated and had less access to knowledge and information, which might have reduced their efficiency. Sale of a larger proportion of output at the market place rather than at farm gate (Z9) and sale of a higher proportion of output through contract (Z10) both significantly re- duced inefficiency in the North, but sale at market increased inefficiency, and contract sale had no effect in the South. These differences might have resulted from different prices received for products and different transaction costs in different market outlets. Higher proportion of veterinary inputs and stocks received from the government insti- tutions (Z11) significantly increased inefficiency in the South but had no effect in the North. More frequent extension visits by government and other formal organisations (Z12) significantly reduced inefficiency in the North but had no effect in the South. Thus, it appears that government supplied inputs and services had different effects on efficiency in the two regions perhaps because of the differences in quality and timeliness of the services provided. Generally, government supplied inputs may not always be of best quality and may also not be accessible at the optimum time, which may affect pro- ductivity and efficiency. Higher proportion of home-produced crude feed material (Z13) significantly increased inefficiency in the South perhaps because of the poor quality of such material, but it had no significant effect in the North perhaps because the quality was fairly uniform among all users.

4.3.2 Distribution of farm-specific efficiency for poultry production

The predicted mean efficiency for the sample is about 77% in the North and 70% in the South (Table 18). Under the existing circumstances, a higher proportion of producers in the North are operating at a higher level of technical efficiency. However, most pro- ducers in the North are using local breeds with lower production potential than exotic or crossbreds. In the South, the adoption rate for improved breeds is higher and the level and variability in efficiency is also higher. In both regions, the median is higher than the mean, which is not unusual for a negatively skewed distribution.

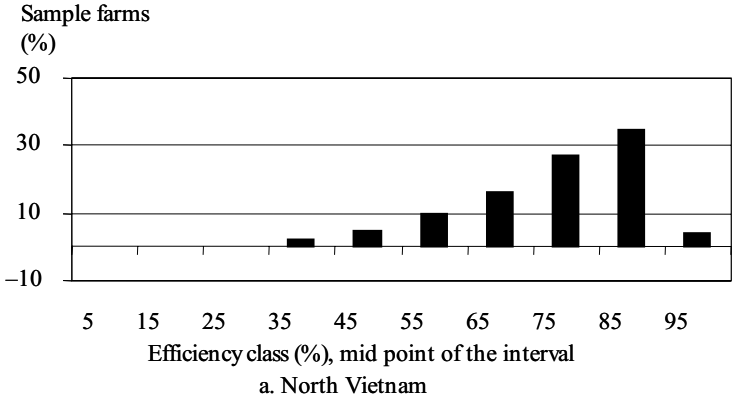
Table 18. Summary statistics for farm-specific economic efficiencies, chicken sector, North and South Vietnam, 1999.

Statistics for economic efficiency (%)	North	South
Mean efficiency	76.8	69.4
Median	78.2	74.6
Standard deviation	11.1	17.2
Variance	123.0	295.9
Minimum	9.8	0.4
Maximum	100.0	94.7
Skewedness	–1.5	–1.6

Kurtosis	7.2	5.2

Source: IFPRI (2001).

The distribution of efficiencies of individual farms in the North and the South are depicted in Figure 1. The distribution is more skewed in the South but almost sym-



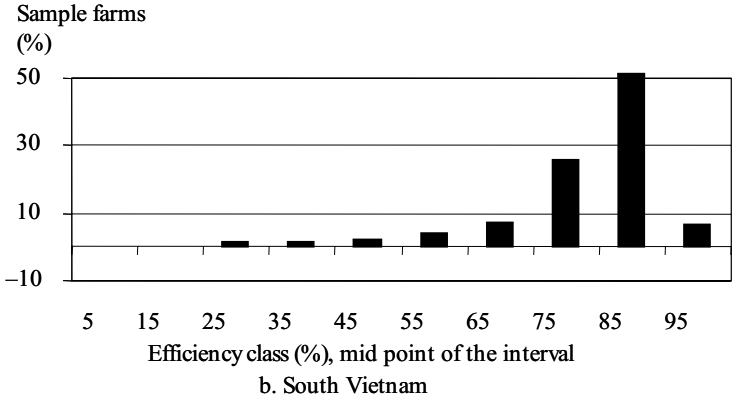


Figure 1. Distribution of predicted efficiencies of farms, chicken sector,

metric and mesokurtic after the 50 to 60% interval in both regions. In the North, efficiency levels rise slowly from the 20 to 30% interval and sharply from the 60 to 70% interval to a maximum in the 70 to 80% interval, then drop very sharply in the 80 to 100% interval. On the other hand, the distribution in the South is highly skewed, has a long thin tail on the left, gradually rising from the 0 to 10% interval to 50 to 60% interval and then rising sharply to a maximum in the 70 to 80% interval, and then dropping.

It is of obvious policy interest to identify the important characteristics of least performing and best performing farms. Following Okike et al. (2001), we classify the top 10% of the farms to be most efficient and the bottom 10% to be least efficient. Thus, the groups constitute a thick frontier at the top and another thick frontier at the bottom.

The characteristics of least efficient, most efficient, and all farms in the North and the South are shown in Tables 19 and 20, respectively. In the North, the mean values

of all the inputs per unit of output are higher for the least efficient farms. Per unit use of three of the most important inputs, namely stocks, and purchased crude feeds, are par- ticularly significantly higher for the least efficient farms. Among the factors that affect inefficiency, the mean values of almost all the factors are higher for the efficient farms (except for age of the producer and use of inputs from government sources). The level of education is significantly higher for the most efficient farms, indicating that education plays a very important role in reducing inefficiency.

Table 19. Selected characteristics of least and most efficient farms, chicken sector, North Vietnam, 1999.

Variables/characteristics	Least efficient (n = 79)	All farms (n = 788)	Most efficient (n = 79)	p > t/ p < t
Mean efficiency (%)	52.96	76.81	91.50	0.00
Value of output (VND 10^3/household)	4758.00	26,369.80	86,569.00	0.00
Value of parent stocks (VND 10^3/kg live weight)	6.34	3.33	3.54	0.01
Annual labour (days/kg live weight)	0.35	0.14	0.06	0.00
Crude feeds purchased (kg/kg live weight)	2.62	1.33	0.71	0.00
Concentrate feed (kg/kg live weight)	0.67	0.44	0.60	0.40
Home-produced feed (kg/kg live weight)	3.53	1.66	0.83	0.00
Housing area (m^2/kg live weight)	0.27	0.14	0.06	0.00
Veterinary cost (VND 10^3/kg live weight)	0.15	0.15	0.06	0.01
Age of producers (years)	45.53	45.32	43.44	0.07
Adult members for farm work (persons/hh)	2.25	2.43	2.54	0.06
Cultivated land (ha/hh)	0.25	0.33	0.57	0.08
Average education level	3.00	3.30	3.38	0.00
Credit for poultry (VND × 10^3/live weight)	0.00	282.49	1937.00	0.01
Distance of the nearest major market (km)	0.93	1.30	1.69	0.05
Output sold in the market (%)	29.96	31.97	19.75	0.10
Output sold by contract (%)	0.01	2.71	16.33	0.00
Veterinary inputs and stocks from government/co-operatives (%)	41.56	42.37	37.72	0.01
Mean visits by government service providers	0.04	0.19	0.58	0.03

Note: The last column shows the level of significance for t-test for testing the differences of mean characteristics between least efficient and most efficient farms.
Source: IFPRI (2001).

In the South, input use by the least efficient farms is also higher as in the North (Table 20). Among the variables that influence inefficiency, the most noteworthy difference between the North and the South is observed in the use of credit. Unlike in the North, the efficient farms in the South use less credit. Also, the most efficient producers in the South sell proportionately less the longer the distance from the secondary market. Thus, market conditions contribute to the higher level of inefficiency in the South to a greater extent. Unlike in the North, the most efficient farmers in the South are older.

The distribution of the least and most efficient farms also varies across the agro-ecological zones. In the North, the Red River Delta contains a higher proportion of least and most efficient farms than its share of the sample (Table 21). By contrast, the North- East and North Central Coast contain a lower proportion of both least and most ef- ficient farms than their shares in the sample. In the South, the South Central Coast con- tains a relatively higher proportion of least efficient farms compared to its share in the sample. The Central Highland contributes less to both least and most efficient farms. The North-East South and Mekong River Delta contribute more to most efficient farms in relation to their shares in the sample.

Table 20. Selected characteristics of least and most efficient farms, chicken sector, South Vietnam, 1999.

Variables/characteristics	Least efficient (n = 25)	All farms (n = 253)	Most efficient (n = 25)	p > t/ p < t
Economic efficiency (%)	28.17	69.38	87.86	0.00
Value of output (VND × 10^3/household)	9385.60	116,297.50	478,846.00	0.00
Value of parent stocks (VND × 10^3/kg live weight)	7.90	5.35	2.74	0.01
Annual labour (days/kg live weight)	2.35	0.33	0.15	0.05
Crude feed purchased (kg/kg live weight)	35.66	4.49	0.74	0.14
Concentrate feed (kg/kg live weight)	13.16	2.43	0.88	0.13
Home-produced feed (kg/kg live weight)	24.27	2.86	0.04	0.10
Housing area (m^2/kg live weight)	1.49	0.22	0.05	0.07
Veterinary cost (VND × 10^3/kg live weight)	16.77	2.13	0.12	0.16
Age of the producer (years)	40.80	44.32	44.38	0.09
Adult members for farm work (persons/household)	1.92	2.00	2.00	0.71
Cultivated land (ha/household)	0.27	0.39	0.64	0.09
Average education level (1, 2, … 7)	3.08	3.30	3.58	0.19
Credit for poultry (VND × 10^3/kg live weight)	7979.00	1695.95	28.82	0.01
Distance of the nearest major market (km)	2.13	2.55	3.17	0.09
Output sold in the market (%)	58.00	26.13	12.70	0.00
Output sold by contract (%)	0.01	4.11	7.12	0.09
Veterinary inputs and stocks from government/co-operatives	53.40	24.94	14.00	0.00
Mean visits by government organisations and co-operatives	0.60	0.20	0.10	0.04

Note: the last column shows the level of significance for t-test for testing the differences of mean characteristics between least efficient and most efficient farms.
Source: IFPRI (2001).

Table 21. Distribution of the least and most efficient farms by agro-ecological regions, chicken sector, Vietnam, 1999.

Regions	North (%)			Regions	South(%)		
	Sample	Least efficient	Most efficient		Sample	Least efficient	Most efficient
Red River Delta	33	47	45	South Central Coast	33	48	26
North East	34	31	25	Central Highlands	13	4	4
North West	11	9	10	North-East South	21	8	35
North Central Coast	22	13	20	Mekong River Delta	33	40	35
Total	100	100	100	Total	100	100	100

Source: IFPRI (2001).

The distribution of least and most efficient farms is shown according to breeds of poultry produced, species mix and type of business (Table 22). Farms having local breed and crossbred poultry in the North contribute proportionately more to the least efficient category and proportionately less to the most efficient category in relation to their shares in the sample. By contrast, exotic poultry producers in the North contribute proportion- ately more to the most efficient category in relation to their share in the sample. In the South, the distribution for exotic poultry is quite similar, but for local breed and cross- bred the pattern is slightly different. Here, local breed poultry producers contribute less to both the least efficient and most efficient categories, but crossbred poultry producers contribute most to the least efficient category. Exotic poultry producers in both regions belong more to the most efficient category and operate at a higher level of efficiency.

Table 22. Distribution of the least and most efficient farms by farm types, chicken sector, Vietnam, 1999.

Farm types	North (%)			South (%)		
	Sample	Least efficient	Most efficient	Sample	Least efficient	Most efficient
Poultry breeds						
Local only	67	68	43	22	12	13
Crossbred only	3	4	2	17	44	19
Exotic only	25	24	52	57	40	64
Mixed	5	4	3	4	4	4
Total	100	100	100	100	100	100
Species mix						
Poultry only	9	7	19	55	48	69
Poultry and other livestock	91	93	81	45	52	31
Total	100	100	100	100	100	100
Business type						
Household farm	53	57	33	31	44	12
Commercial farm	47	43	67	69	56	88
Total	100	100	100	100	100	100

Source: IFPRI (2001).

Specialised farms that produce only poultry rather than mixed livestock contribute proportionately more to the most efficient category in relation to their share in the sample. By contrast, mixed livestock farms contribute proportionately more to the least efficient category. This result is similar in both regions. Moreover, a larger proportion of household farms belongs to the least efficient category and a larger proportion of commercial farms belongs to the most efficient category in both regions.

4.4 Efficiency in pig production

4.4.1 Pig production behaviour and inefficiency effects

The maximum-likelihood estimates of the parameters in the stochastic frontier and inefficiency model for the producers in the North and South are presented in Tables 23 and 24. The values of the ^{2}, , log likelihood function and test statistic and their significance level indicate that inefficiency effects of a stochastic nature exist at a higher degree in the North and marginally in the South. The estimated coefficients of the input variables of the frontier production function are all positive, as would be expected. All are significant at the 1% level except for veterinary costs in the South, where producers spend more on vet- erinary fees and drugs. About 70% of the cost was due to vaccination and 19% was due to artificial insemination compared to 52 and 6%, respectively, for these two items in the North. Artificial insemination, especially for pig production, is very expensive in Vietnam (IFPRI 2001). By contrast, spending on disinfection and internal parasite control, which are directly related to productivity, is much higher in the North (26% of total veterinary cost compared to 6% in the South). The size of all input elasticity is small and their sum equals less than unity indicating decreasing returns to scale.

Table 23. Maximum likelihood estimates for parameters of the stochastic frontier and inefficiency models, pig sector, North Vietnam, 1999.

Production factors	Coefficients	Inefficiency factors	Coefficients
Constant	2.123*** (0.195)	Constant	–0.251 (0.312)
Stock (ln X1)	0.255*** (0.017)	Producer age (Z1)	0.009*** (0.004)
Labour use (ln X2)	0.050*** (0.023)	Labour supply (Z2)	–0.027 (0.033)
Feed (ln X3)	0.546*** (0.023)	Land size (Z3)	–0.596*** (0.213)
Crude feed ratio (ln X4)	–0.009 (0.025)	Herd size (Z4)	–0.0005*** (0.0001)
Housing (ln X5)	0.049*** (0.016)	Credit use (Z5)	0.006 (0.079)
Veterinary cost (ln X6)	0.043*** (0.011)	Education of household head (Z6)	–0.082*** (0.041)
Farm type (D1)	0.160*** (0.031)	Gender of hh head (Z7)	0.134** (0.081)
Crossbred (D2)	0.661*** (0.060)	Market access (Z8)	–0.271*** (0.024)
Exotic breed (D3)	0.411*** (0.124)	Sale at market place (Z9)	0.010*** (0.004)
Mixed breeds (D4)	0.419*** (0.059)	Government inputs (Z11)	0.003*** (0.001)
Enterprise mix (D5)	–0.055* (0.038)	Visits by government service providers (Z12)	–0.015* (0.011)
North-East (D6)	–0.085*** (0.038)	Home made crude feed (Z13)	1.190*** (0.153)
North-West (D7)	–0.157*** (0.055)		

North Central Coast (D8)	0.041 (0.044)

Variance (= σ^2) = 0.307*** (0.031); σ^2_u/σ^2 = ã = 0.617*** (0.046).
Log-likelihood function = –630.92; Test statistic λ (df = 14)[1] = 165.40***.
***, ** and * show statistical significance at the 1, 5 and 10% levels respectively. Figures in parentheses are standard errors.
1. A note on this test is provided in Table 15.
Source: IFPRI (2001).

The coefficient of the ratio of crude materials and fodder crops to total feed is negative in both regions indicating that concentrate feeds are more productive than crude feed materials and fodder crops. The positive and significant coefficient for farm type dummy (D1) in both regions indicates that commercial farms are more productive than household farms. The coefficients of dummies representing different improved breed pig production indicate that the improved breeds, especially crossbreds in the North and exotic breeds in the South, are more productive than local breeds. Specialised pig pro- ducers are more productive than those mixing pig with other livestock species in both regions.

In the North, producers in the North-East and North-West regions are less productive than those in the Red River Delta and North Central Coast. In the South, com- pared to producers in the South Central Coast, those in all the three other regions are significantly more productive.

Table 24. Maximum likelihood estimates of the stochastic frontier and inefficiency models, pig sector, South Vietnam, 1999.

Production factors	Coefficients	Inefficiency factors	Coefficients
Constant	2.070*** (0.158)	Constant	–4.569*** (1.057)
Stock (ln X1)	0.081*** (0.017)	Producer age (Z1)	0.036*** (0.010)
Labour use (ln X2)	0.072*** (0.023)	Labour supply (Z2)	0.133*** (0.067)
Feed (ln X3)	0.755*** (0.023)	Land size (Z3)	–0.266*** (0.106)
Crude feed ratio (ln X4)	–0.023*** (0.007)	Herd size (Z4)	–0.0002*** (0.00001)
Housing (ln X5)	0.026*** (0.013)	Credit use (Z5)	–1.823*** (0.482)
Veterinary cost (ln X6)	0.005 (0.007)	Education of hh head (Z6)	–0.288*** (0.085)
Farm type (D1)	0.150*** (0.036)	Gender of hh head (Z7)	0.437*** (0.193)
Crossbred (D2)	0.266*** (0.068)	Market access (Z8)	–0.009*** (0.001)
Exotic breed (D3)	0.448*** (0.081)	Sale at market place (Z9)	–0.039*** (0.011)
Mixed breeds (D4)	–0.011 (0.095)	Government inputs (Z11)	0.010*** (0.002)
Enterprise mix (D5)	–0.055* (0.039)	Visits by government service providers (Z12)	0.019*** (0.006)
Central highlands (D9)	0.272*** (0.053)	Home made crude feed (Z13)	1.735*** (0.430)
North-East south (D10)	0.380*** (0.064)		
Mekong Delta (D11)	0.390*** (0.052)		

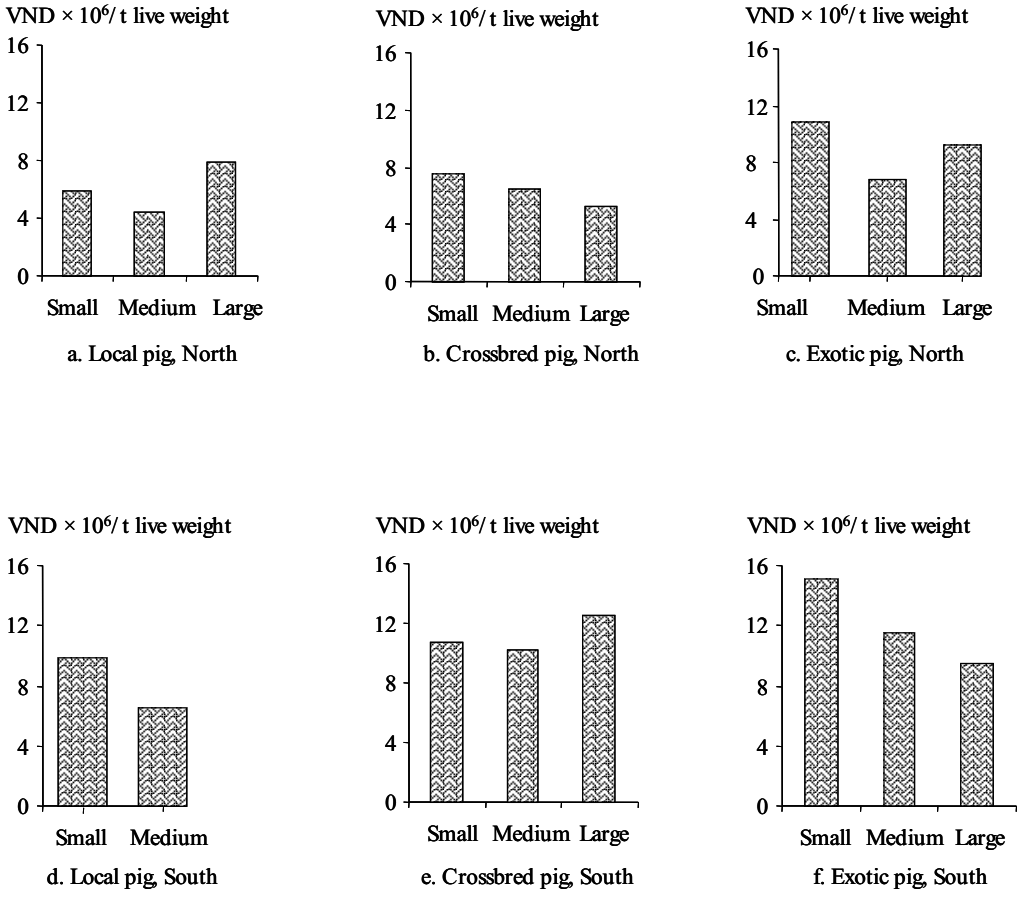


Figure 2. Average cost of production per tonne of live weight for pig by breed, herd size and region,

Variance = σ^2 = 1.167*** (0.165); σ^2_u/σ^2 = $\tilde{a}$ = 0.923*** (0.011)
Log-likelihood function = –316.10; Test statistic λ (df = 14)[1] = 182.24***
***, ** and * show statistical significance at the 1, 5 and 10% levels respectively. Figures in parentheses are standard errors.
1. A note on this test is provided in Table 15.
Source: IFPRI (2001).

Among the 12 factors considered for explaining inefficiency, all are significant at 10% level or less in the South and 10 are significant in the North (Tables 23 and 24). Land size, herd size, education of household head and market distance significantly reduced inefficiency, while age of household head, female-headed households, more access to government supplied inputs and higher proportion of family supplied crude feed materials significantly increased inefficiency in both the regions. The explanations for these effects are similar to those explained for poultry production. On average, scale economies exist for crossbred pig in the North and local and exotic pig in the South (Figure 2). In other cases, medium farms had the lowest per unit cost. In fact, medium farms for all breeds were earning higher rates of profit. In the North, large local pig farmers were merely breaking even and producing exotic breeds were making losses. A

comparison of cost components by size of operation shows that cost economies were derived from labour in all cases and from feed in some cases. Stock purchases and veterinary cost increased with the herd size. However, lower veterinary expenses by smallholders may not be a reflection of cost economy but rather their inability due to lack of cash or lack of information to spend enough in this important area to enhance productivity.

Female household heads were less efficient as they had lower education and less access to knowledge and information. In the sample of pig farmers in the North, 20% of the household heads are females. About 25% of the female heads have education above middle school compared to 32% of the male heads. In the South, 37% of the male heads have education above middle school compared to 25% of the female heads.

The direction of influence of some other factors differs between the two regions. Increased family labour supply significantly increased inefficiency in the South, perhaps because available labour could not be fully used, but it had no effect in the North. Use of credit significantly reduced inefficiency in the South, perhaps by allowing purchase of better quality inputs and services, but it had no effect in the North. Higher proportion of sale of output at the market place significantly reduced inefficiency in the South, but had an opposite effect in the North, perhaps because of differences in prices received and transaction costs. Higher number of visits by government and formal organisations providing services significantly increased inefficiency in the South, but had the opposite effect in the North perhaps because of the differences in the quality and timeliness of the services provided.

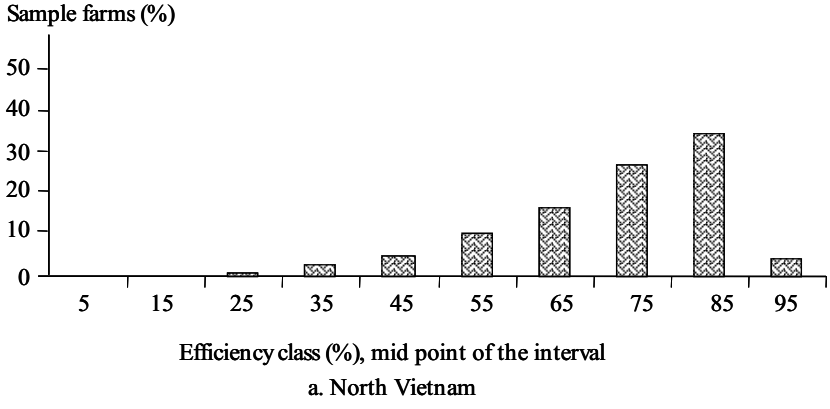
4.4.2 Distribution of farm-specific efficiency for pig production

The predicted mean economic efficiency for the sample in the North is about 72% and in the South is 78% (Table 25). The median is higher than the mean in both regions, which is usual for a negatively skewed distribution. The distribution of efficiency of indi- vidual farms in the North and the South are depicted in Figure 3 (a and b respectively). The distribution is less skewed in the North than in the South. In the North, it is rising gradually from the 10 to 20% interval to a maximum in the 80 to 90% interval, and then dropping very sharply in the 90 to 100% interval. On the other hand, the distri- bution in the South has a thin tail on the left, rising slowly from the 10 to 20% interval, then rising at a faster rate from 60 to 70% interval to a maximum in the 80 to 90% in- terval, and then dropping sharply.

Table 25. Summary statistics for farm-specific efficiencies, pig sector, North and South Vietnam, 1999.

Statistics for efficiency (%)	North	South
Mean	73.0	77.9

Median	76.3	81.7
Standard deviation	14.0	13.4



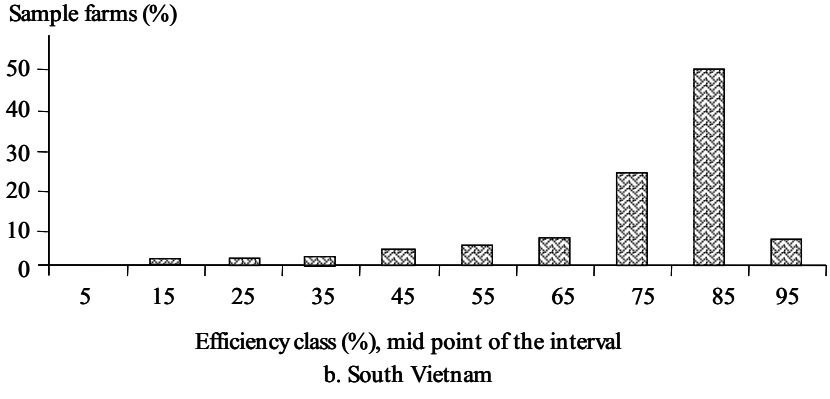


Figure 3. Frequency distribution of pig farms by predicted efficiency levels, Vietnam.

Variance	195.9	180.6
Minimum	9.4	12.9
Maximum	94.8	100.0
Skewedness	–1.1	–2.1
Kurtosis	3.9	8.0

Following the earlier analysis with respect to poultry, we classify farms into the least efficient and most efficient categories on the basis of ranking by efficiency level. The top 10% of the farms are considered to be most efficient and the bottom 10% to be the least efficient ones. Thus, the groups constitute a thick frontier at the top and another thick frontier at the bottom.

The characteristics of the least and most efficient farms in the North are presented in Table 26. The mean value of all the inputs per animal unit is higher for the least efficient farms except concentrate feed, which is lower than most efficient farms. Among the factors which affect inefficiency, the most efficient farms have more cultivated land, use higher amount of credit, travel longer distances to access secondary markets to sell the product, have larger herd size, and get more frequent visits from government organ- isations and co-operatives service providers. By contrast, the least efficient farms have older household heads, more adult members for farm work, sell proportionately more output in the market place, and use more inputs from government sources.

In the South, inputs per animal unit have the same pattern as in the North, but unlike in the North, the least efficient farms in the South also use higher concentrate feed per unit of animal (Table 27). Among the variables that influence inefficiency, the most noteworthy difference between the North and the South is observed in the use of credit and markets. Unlike in the North, the most efficient farms in the South use less credit and sell proportionately more in the market.

The distribution of most efficient and least efficient farms by agro-ecological regions shows that, in the North, the Red River Delta contains a higher proportion of both least efficient and most efficient farms than its share of the sample (Table 28). By contrast, the North Central Coast contains a lower proportion of both least and most efficient farms than its share in the sample. The North-East contains proportionately more of the most efficient farms and the North-West contains proportionately more of the least efficient farms. Linking this result with the maximum likelihood estimates reported in Table 23, we note that productivity is significantly lower both in the North-East and North-West. Thus, higher efficiency may be attained at lower levels of productivity, in which case pro- ductivity-enhancing technology has to be used to get out of lower income categories.

Table 26. Selected characteristics of least efficient and most efficient farms, pig sector, North Vietnam, 1999.

Variables/characteristics	Least efficient farms (n = 112)	All farms (n = 1120)	Most efficient farms (n = 112)	p> t/ p < t
Mean efficiency (%)	42.97	72.98	90.04	0.00
Value of output (VND × 10^3/household)	6414.70	37,728.30	14,7779.10	0.00
Value of parent stocks (VND × 10^3/animal)	98.18	90.86	87.82	0.14
Annual labour (days/animal)	10.74	5.32	2.58	0.00
Total feed (kg/animal)	282.04	220.48	151.19	0.00
Crude feed purchased (kg/animal)	276.21	213.74	138.10	0.00
Concentrate feed (kg/animal)	5.87	6.74	13.10	0.04
Home-produced feed (kg/animal)	206.52	126.71	40.84	0.00

Housing area (m^2/animal)	0.87	0.75	0.51	0.07
Veterinary cost (VND × 10^3/animal)	2.24	2.23	1.82	0.22
Age of the producer (years)	48.86	44.49	41.28	0.01
Adult members for farm work (persons/household)	2.46	2.43	2.29	0.10
Cultivated land (ha/household)	0.30	0.34	0.50	0.03
Credit for pig (VND × 10^3/animal)	3527.00	13,795.80	8272.70	0.14
Average education level	2.95	3.26	3.44	0.00
Distance to nearest major market (km)	1.41	1.50	1.68	0.07
Output sold in the market (%)	2.32	0.48	0.45	0.03
Veterinary inputs and stocks from government/co-operatives (%)	44.25	31.55	20.09	0.00
Herd size (number of animal)	58	100	687	0
Average no. of visit by government service providers	3	4	4	0

Note : The last column shows the level of significance for t-test for testing the differences of mean characteristics between least efficient and most efficient farms.
Source: IFPRI (2001).

Table 27. Selected characteristics of least efficient and most efficient farms, pig sector, South Vietnam, 1999.

Variables/characteristics	Least efficient farms (n = 63)	All farms (n = 631)	Most efficient farms (n = 63)	p > t/p < t
Mean efficiency (%)	44.94	77.94	90.89	0.00
Value of output (VND × 10^3/household)	29,942.50	226,445.00	1,087,103.00	0.04
Value of parent stocks (VND × 10^3/animal)	276.15	283.33	227.38	0.06
Annual labour (days/animal)	10.02	5.48	3.82	0.00
Total feed (kg/animal)	385.23	212.56	142.06	0.01
Crude materials, fodder crops (home produced plus purchased) (kg/animal)	245.07	141.11	102.61	0.00
Concentrate feed (kg/animal)	140.18	71.45	39.45	0.17
Home produced feed (kg/animal)	83.77	29.52	5.71	0.00
Housing area (m^2/animal)	3.70	1.30	0.89	0.04
Veterinary cost (VND × 10^3/animal)	5.12	7.95	5.20	0.57
Age of the producer (years)	49.60	45.50	44.30	0.01

Adult members for farm work (persons/household)	2.40	2.10	1.86	0.01
Cultivated land (ha/household)	0.45	0.52	0.57	0.41
Credit for pig (VND × 10^3/animal)	67,887.80	17,482.00	6510.20	0.25
Average education level	2.78	3.22	3.32	0.01
Distance from the nearest major market (km)	5.69	6.86	16.92	0.15
Output sold in the market (%)	0.86	1.81	9.52	0.01
Veterinary inputs and stocks from government/co-operatives (%)	29.95	19.74	16.89	0.02
Herd size (number of animal/household)	57.52	237.00	1059.00	0.05
Average number of visit by government service providers	7.75	7.93	5.38	0.04

Note : The last column shows the level of significance for t-test for testing the differences of mean characteristics between least efficient and most efficient farms.
Source: IFPRI (2001).

Table 28. Distribution of the least efficient and most efficient farms by agro-ecological regions, pig sector, Vietnam, 1999.

	North (%)				South (%)		
Regions	Sample	Least efficient	Most efficient	Regions	Sample	Least efficient	Most efficient
Red River Delta	35	39	41	South Central Coast	27	37	32
North-East	31	29	34	Central Highlands	14	21	6
North-West	11	16	9	North-East South	25	8	27
North Central Coast	23	16	16	Mekong River Delta	34	34	35
Total	100	100	100	Total	100	100	100

Source: IFPRI (2001).

In the South, the South Central Coast contains more of both least and most efficient farms compared to its share of the sample. The Central Highland contributes more to least efficient farms. The North-East South contributes as much as its proportion in the sample to most efficient farms. The Mekong River Delta contributes as much as its pro- portion in the sample to both least and most efficient farms.

Among various farm type categories, producers of local breed contribute more to the least efficient category in relation to its share of the sample (Table 29). By contrast, pro- ducers of exotic pig contribute more to the most efficient category. Producers of cross- bred pig contribute proportionately less than their sample share to both least and most efficient categories. By contrast, producers of mixed breed pig contribute proportionately more than their sample share to both least and most efficient categories. The pattern is similar across the North and South regions, except that producers of crossbred pig con- tribute more to both least and most efficient farm categories.

Table 29. Distribution of the least efficient and most efficient farms by farm types, pig sector, Vietnam, 1999.

	North (%)			South (%)		
Farm types	Sample	Least efficient	Most efficient	Sample	Least efficient	Most efficient
Breeds						
Local only	6	14	5	7	16	8
Crossbred only	48	33	36	42	49	45
Exotic only	2	2	7	47	25	41
Mixed	44	51	52	4	10	6
Total	100	100	100	100	100	100
Enterprise mix						
Pig only	22	12	38	73	60	73
Pig and other livestock	78	88	62	27	40	27
Total	100	100	100	100	100	100
Business type						
Household farm	58	68	36	63	68	49
Commercial farm	42	32	64	37	32	51
Total	100	100	100	100	100	100

Source: IFPRI (2001).

Specialised farms belong more to the most efficient category and by contrast, mixed livestock farms belong more to the least efficient category. Household farms belong more to the least efficient category and by contrast commercial farms belong more to the most efficient category. This pattern is similar in both regions.

4.5 Summary

In general, there are significant differences in production behaviour and efficiency level between the North and the South, between poultry and pig production, among different breeds of poultry and pig production, between mixed and specialised farms, between household and commercial farms, and among producers located in different agro- ecological regions.

Chicken production exhibited economies of scale in the North but not so clearly in the South. Exotic and local pig production in the South and crossbred pig in the North exhibited economies of scale, while medium size farms were most cost efficient for exotic and local pig in the North and crossbred pig in the South. This suggests that a liberal- isation policy may improve efficiency and competitiveness in both poultry and pig pro- duction in the North, because flock and herd sizes may expand due to lower input prices. However, it may cause inefficiency in the South if the same argument is used for output expansion and poultry and pig farms in the South become too large and lose the cost advantage due to lower technical performance.

There are some differences in the set of factors that influence efficiency and the direc- tion of such influence. The use of better quality feed improved efficiency as would be ex- pected but a significant proportion of crude materials and fodder crops were still being used. Moreover, a higher dependence on home-produced crude materials reduced ef- ficiency due to their poor quality. Therefore, to attain the production potential of im- proved breeds in smallholder conditions, much can be gained by improving feed quality and management. Policy support through extension, information dissemination, credit and market access to attain this goal may be the key to alleviate poverty among small- holders and let them participate in the market-driven rural development process.

Education significantly improved efficiency level so that more access to formal and informal education, especially for women, may help smallholders to become more ef- ficient and competitive. Access to credit generally improved efficiency by leveraging cash constraints to buy better quality inputs and services; so easier access to credit to cash- constrained farmers will improve efficiency. Better access to secondary markets improved efficiency and thus investment in road and market infrastructure can improve efficiency. Contract sale was not common and where practised, it improved efficiency perhaps be- cause of the guaranteed market and prices. If the size of operation in the industry gets bigger and smallholding becomes less competitive, contract farming may provide the second best option for smallholders to stay in business. Increased dependence on govern- ment supplied inputs such as feeds, stocks and drugs reduced efficiency, the reasons are unclear. If this was due to poor quality and untimely delivery of such inputs, then cor- rective measures need to be taken in this regard. On the other hand, increased number of extension visits has improved efficiency. Private extension delivery is still not available. Therefore, to optimise public investment for improving productivity and efficiency, especially of the smallholders, the government should fully withdraw from input supply businesses consistent with the policy of liberalisation. Instead, public expenditure on ex- tension and education and specialised training should be expanded as these have sig- nificant positive effect on efficiency and there are no alternative suppliers.

5 Summary and conclusion

This study examined the competitiveness and efficiency of poultry (egg and meat) and pig production in Vietnam using the policy analysis matrix (PAM) and stochastic frontier production function, respectively. Local and exotic breeds as well as their crosses were considered for both species. Data from a stratified sample of 1118 poultry and 1962 pig farms collected in 1999–2000 had been used.

The results of the PAM showed that poultry was generally competitive in Vietnam except meat and egg production with local breeds and egg production with both cross-breds in the North and local breeds in the South, for which productivity was low and per unit cost was high. Domestic prices of both outputs and inputs were higher than world prices. If output prices fell moderately due to withdrawal of protective policies and slow down in current high level domestic demand, profitable breeds would still remain com- petitive.

Pig production was also highly competitive, especially with local and crossbreds in the North and exotic breeds in the South. Existing tax policy and market price conditions of higher input and lower output prices in the North were supportive of expanded pro- duction throughout the country and apparently benefit producers in the South more. A liberalisation policy may, thus, improve competitiveness in both poultry and pig pro- duction in the North, because flock and herd sizes may expand because of lower input prices. Furthermore, private profits for some enterprises in the South were much higher than social profits, indicating a higher degree of imperfection in the market and, there- by, scope for increasing production through adoption of measures that can enhance competition.

The results of the PAM were based on average farm performance, but efficiency might vary across farms of different types and sizes, thereby making some farms more competitive in the market than others. The results of frontier production function estimates showed that there were differences in the average level of efficiency between pig and poultry farms, and between the North and the South. There were economies of scale in some breeds of pig and exotic poultry production. Medium farms were more cost ef- fective, and smallholders were least efficient so they might not be able to compete in a more liberalised economic environment with low productive local breeds and higher per unit cost. Thus, they might fail to reap the benefits of an expanded, demand-led market. Indeed, they might be pushed out of the market, thereby aggravating poverty and un- employment. To avoid such a situation, active policy support in favour of smallholders was essential to help them stay in business and grow sufficiently in size to achieve eco- nomies of scale and be more competitive.

There were some differences in the set of factors that influence efficiency and the di- rection of such influence. The use of better quality feed improved efficiency although a significant proportion of crude materials and fodder crops were still being used. Higher dependence on home-produced poor quality crude materials on the other hand reduced efficiency, and this was especially true in the North. Much could therefore be gained by improving feed quality and management in helping attain the

production potential of improved breeds in smallholder conditions. Results also indicated that policy support through extension and information dissemination and other institutional innovation to attain this goal might be the key to alleviate the poverty of smallholders and enable them to participate in the market-driven rural development process.

Education significantly improved efficiency level. More access to formal and informal education, especially for women, helped smallholders become more efficient and com- petitive. Access to credit generally improved efficiency by leveraging cash constraints to buy better quality inputs and services; and thus easier access to credit for the cash- constrained farms would help improve overall efficiency. Access to secondary markets improved efficiency and thus investment in rural roads and market infrastructure gene- rally contributes to efficiency. Contract sale was not common and, where practised, it improved efficiency perhaps because of the guaranteed market and prices. If the industry moved towards larger size operations, contract farming may remain a second best avenue for smallholders to remain in business, though policies should also discourage the emerg- ence of monopolies. Increased dependence on government supplied inputs such as feeds, stocks and drugs reduced efficiency, and there was a need to investigate if this was due to the poor quality and untimely delivery of such inputs. Increased number of exten- sion visits had improved efficiency. Private extension delivery was still not available. Therefore, to optimise public investment for improving the productivity and efficiency, especially of smallholders, the government should fully withdraw from input supply busi- nesses in accordance with the demands of liberalisation policies. Public expenditure on extension and education and specialised training should instead be expanded as these have significant positive effect on efficiency and that there are no alternative suppliers of these services.

References

Aigner D.J. and Chu S.F. 1968. On estimating the industry production function. American Economic Review 58:826–839.

Aigner D.J., Lovell K. and Schmidt P. 1977. Formulation and estimation of stochastic frontier production function models. Journal of Econometrics 6:21–37.

Akter M.S. and Islam M.M. 1986. Spatial and inter-temporal price differentials of Boro Paddy in Bangladesh. The Agricultural Marketing (July—September) 6–10.

Bardhan P.K. 1973. Size, productivity and returns to scale: An analysis of farm level data in Indian agriculture. Journal of Political Economy 81:1370–86.

Battese G.E. and Coelli T. 1988. Prediction of firm-level technical efficiencies with a generalized frontier production function and panel data. Journal of Econometrics 38:387–399.

Battese G.E. and Coelli T. 1992. Frontier production functions, technical efficiency and panel data: With application to paddy farmers in India. The Journal of Productivity Analysis 3:153– 169.

Battese G.E. and Coelli T. 1993. A stochastic frontier production function incorporating a model for technical inefficiency effects. Working Papers in Econometrics and Applied Statistics 69. Department of Econometrics, University of New England, Armidale, Australia. 42 pp.

Bravo-Ureta B.E. and Pinheiro A.E. 1993. Efficiency analysis of developing country agriculture: A review of the frontier function literature. Agriculture and Resource Economics Review 22:88–101.

Charnes A., Cooper W.W. and Rhodes E. 1978. Measuring the efficiency of decision making units. European Journal of Operational Research 2:429–444.

Chenery H.B. 1961. Comparative advantage and development policy. American Economic Review 51(1):18–51.

Coelli T.J. 1994. A guide to frontier version 4.1: A computer program for stochastic frontier production and cost function estimation. Department of Econometrics, University of New England, Armidale, Australia. 34 pp. (mimeo)

Coelli T.J. and Battese G.E. 1996. Identification of factors which influence the technical inefficiency of Indian farmers. The Australian Journal of Agricultural Economics 40(2):103–128.

Delgado C., Rosegrant M., Steinfeld H., Ehui S. and Courbois C. 1999. Livestock to 2020: The next food revolution. Food, Agriculture, and the Environment Discussion Paper 28. IFPRI (International Food Policy Research Institute), Washington, DC, USA; FAO (Food and Agriculture Organization of the United Nations), Rome, Italy; and ILRI (International Livestock Research Institute), Nairobi, Kenya. 72 pp.

Dornbusch R. 1980. Open economy macroeconomics. Basic Books. New York, USA. 230 pp.

Drucker A.G., Gomez V., Ehuan N.F., Rubio O. and Anderson S. 1999. Comparative economic analysis of criollo, crossbreed and imported pigs in backyard production systems of Yucatan, Mexico. Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma de Yucatán. 37 pp. (mimeo)

FAO (Food and Agriculture Organization of the United Nations). 1999. FAO yearbook of trade and commerce 1998. Volume 52. FAO, Rome, Italy. 380 pp.

Farrell M.J. 1957. The measurement of productive efficiency. Journal of the Royal Statistical Society (Series A General) 120:253–281.
Forsound F., Lovell C.A.K. and Schmidt P. 1980. A survey of frontier production functions and their relationship to efficiency measurement. Journal of Econometrics 13:5–26.
Fox R., Finan T., Pearson S. and Monke E. 1990. Expanding the policy dimension of farming systems research. Agricultural Systems 33:271–287.
Gittinger J.P. 1982. Economic analysis of agricultural projects. 2nd ed. Johns Hopkins University Press, Baltimore, USA. 505 pp.
Gotsch C. 1989. Agricultural policy analysis on electronic spreadsheets: Commodity and farming systems models. Farm Management and Production Economics Service, Agricultural Services Division, FAO (Food and Agriculture Organization of the United Nations), Rome, Italy. 180 pp.
Greene W. 1992. The econometric approach to efficiency measurement. Department of Economics Working Papers, EC-92-26, Stern School of Business, New York University, New York, USA. 48 pp.
IFPRI (International Food Policy Research Institute). 2001. Policy options for using livestock to promote rural income diversification and growth in Viet Nam. Final Report Volume I. IFPRI, Washington, DC, USA. 246 pp.
ILRI (International Livestock Research Institute). 2000. Handbook of livestock statistics for developing countries. Socio-economic and Policy Research Working Paper 26. ILRI, Nairobi, Kenya. 299 pp.
Itty P. 1996. Profitability, efficiency, and comparative advantage of African cattle meat, and milk production: The case of trypanotolerant village cattle production. Agricultural Economics 14:33–44.
Jondrow J., Lovell C.A.K., Meterov I.S. and Schmidt P. 1982. On the estimation of technical efficiency in the stochastic frontier production functions. Journal of Econometrics 19(2–3): 233–238.
Kalirajan K.P. 1990. On measuring economic efficiency. Journal of Applied Econometrics 5:75–80.
Kumbhakar S.C. and Lovell C.A.K. 2000. Stochastic frontier analysis. Cambridge University Press, Cambridge, UK. 344 pp.
Kumbhakar S.C., Ghosh S.C. and McGuckin J.T. 1991. A generalised production frontier approach for estimating determinants of inefficiency in U.S. dairy farms. Journal of Business, Economics and Statistics 9:279–286.
Lich Le Ba. 2000. Animal development orientation 2000–2010. Department of Agricultural and Forestry Extension, Hanoi, Vietnam. Unpublished paper. 21 pp.
MARD (Ministry of Agriculture and Rural Development). 2000a. Chicken sector in Vietnam. Background paper. MARD, Hanoi, Vietnam. Unpublished document. 62 pp.
MARD (Ministry of Agriculture and Rural Development). 2000b. Analysis of livestock and animal product prices and maize sub-sector. Background paper. MARD, Hanoi, Vietnam. Unpublished document. 37 pp.
Meeusen W. and van den Broeck J. 1977. Efficiency estimation from Cobb-Douglas production function with composed error. International Economic Review 18(2):435–444.
Monke E.A. and Pearson S.R. 1989. The policy analysis matrix for agricultural development. Cornell University Press, Ithaca, New York, USA. 287 pp.

Okike I., Jabbar M.A., Manyong V., Smith J.W., Akinwumi J.A. and Ehui S.K. 2001. Agricultural intensification and efficiency in the West African savannahs: Evidence from northern Nigeria. Socio- economics and Policy Research Working Paper 33. ILRI (International Livestock Research Institute), Nairobi, Kenya. 54 pp.

Reifschneider D. and Stevenson R. 1991. Systematic departures from the frontier: A framework for the analysis of firm inefficiency. International Economic Review 32:715–723.

Russell N.P. and Young T. 1983. Frontier production and the measurement of technical efficiency. Journal of Agricultural Economics 34(2):139–149.

Scott G.J., Rosegrant M.W. and Ringler C. 2000. Roots and tubers for the 21st century: Trends, projections, and policy options. Food, Agriculture, and the Environment Discussion Paper 31. IFPRI (International Food Policy Research Institute), Washington, DC, USA. 63 pp.

Seitz W. 1970. The measurement of efficiency relative to a frontier production function. American Journal of Agricultural Economics 52(4):505–511.

Staal S.J. 1995. Peri-urban dairying and public policy in Ethiopia and Kenya: A comparative economic and institutional analysis. PhD thesis. University of Florida, Gainesville, USA.

Staal S.J. and Shapiro B.I. 1996. The economic impact of public policy on smallholder peri-urban dairy producers in and around Addis Ababa. ESAP Publication 2. ESAP (Ethiopian Society of Animal Production), Addis Ababa, Ethiopia. 57 pp.

World Bank. 2000. Macroeconomic update for Vietnam. East Asia brief. http://www.worldbank.org/eap.

Yao S. 1997. Comparative advantage and crop diversification: A policy analysis matrix for Thai agriculture. Journal of Agricultural Economics 48(2):211–222.