Impact of quality attributes and marketing factors on prices for indigenous pork in Vietnam to promote sustainable utilization of local genetic resources

N V Phuong[3], D T M Hanh[1], T H Cuong[1], A Markemann[2], A Valle Zárate[2] and M Mergenthaler[3]

[1]*Marketing Department, Faculty of Accounting and Business Management, Hanoi University of Agriculture, Vietnam,*

[2]*University of Hohenheim (480a), Animal Breeding and Husbandry in the Tropics and Subtropics, Garbenstr. 17, 70599 Stuttgart, Germany*

[3]*Faculty of Agriculture, South Westphalia University of Applied Sciences, Lübecker Ring 2, 59494 Soest, Germany*
Corresponding author: *phuonglangvan@gmail.com*
Tel: +49-2921 378 104, Fax: +49-2921 378 200

Abstract

Within the food system transformation in developing countries, demand for high quality products increases. In Vietnam pork demand is rapidly growing, leading to supply shortages of high quality pork. The major objective of this study is identification of important factors affecting indigenous pork prices. Meat from Ban pigs – an indigenous pig breed in Vietnam – is mainly sold through specialized restaurants. Therefore 1944 detailed weekly transaction data for one year period from October 2010 to September 2011 from 33 restaurants in four provinces in the north of Vietnam were analyzed by using a hedonic price model to identify factors influencing Ban pig prices.

The empirical results indicate that marketing factors and quality attributes of Ban pig have significant effects on Ban pig prices. An effective method to ensure benefits of increasing Ban prices to smallholders can be seen in the formation and development of a professional breed and marketingorganization that link public and private institutions with an organized farmers association. The latter would safeguard appropriate benefits of the rural poor from a systematic and sustainable marketing of quality-controlled pork of regional origin. At the same time, this would contribute to the sustainable utilization of valuable local genetic resources.

Keywords: Ban pig, hedonic price model, pig market, Vietnam

Introduction

Rising incomes, urbanization and globalization lead to profound changes in the consumption patterns of an increasing number of people in developing and transition countries, particularly in Asia (Phuong et al 2014; Gerbens-Leenes et al 2010; Kearney 2010). These changes are often referred to as the "Westernization" of diets and result in greater

consumption of more high-value agricultural products including animal products like seafood, dairy products and meat (Lipoeto et al 2013; Pingali 2007). Due to such profound transformations of national and international food systems, agricultural producers are challenged to adapt to more commercialized commodity markets and to diversify into new products and markets.

Given its rapid economic development and recent policy reforms, Vietnam is an interesting developing country to study details of the food system transformation. The restructuring process of food supply chains in Vietnam is observed in the context of ongoing economic liberalization (Mergenthaler et al 2009). Agriculture plays an important role in Vietnam's economy, contributing 21% to the GDP and generating about 58% of employment (GSO 2010). Livestock production accounts for 23% of the agricultural output value and receives special attention and priority from the Vietnamese government. In the livestock sector, pigs are one of the most important livestock species (Singh et al 1996; Lemke et al 2008). Pig production remarkably contributed to the success of the government's poverty alleviation policies, especially in rural and remote areas. However, in recent years the number of pig-keeping smallholders has decreased remarkably (Tisdell 2010). This can be attributed to the increasing production costs, particularly feed costs, as well as the spread of diseases, which threatens livestock farming of many poor households, but can also reflect increases in agricultural productivity which favour a transition towards a less agricultural-based economy.

Meanwhile,the demand for meat – particularly pork – has been rapidly increasing (Lapar and Toan 2010) and pig production in Vietnam is far from meeting domestic demand, not to mention demand from regional or global markets, particularly regarding quality and safety attributes (Vu 2003). The shift in domestic demand towards safer and better quality products has likewise become more apparent for fruits and vegetables (Mergenthaler et al 2009), but also for meat (Cuong 2004; Lapar et al 2010; Pedregal et al 2010). Due to increasing urbanization and the associated effect of higher incomes, customers in Vietnam are becoming more sensitive to food safety of animal products and potential health-related issues. Their awareness and demand for better quality, tastier and safer products are increasing. Indigenous pig breeds are thus increasingly becoming a preferred choice of pork consumers in Vietnam, the Ban breed being the most prominent example. Ban pork is perceived to be tastier, more tender and healthier than pork from other local and exotic breeds. Consumers of Ban pork are believed to be of a certain wealth segment, with higher purchasing power and a higher degree of education than the representative consumer. With Vietnam's rapid economic progress, the market for indigenous animal meat seems to offer a great potential for pig producers provided that specific market requirements are clearly understood and can be met by supply chain actors (Huong et al 2009).

For farmers in remote areas of northern Vietnam, the Ban pig has also several advantages. The Ban pig is a native breed that has been domesticated by local people in the northern uplands of Vietnam. Ban pigs also are known as the 'Cap Nach' breed (meaning very small), 'Man' breed (name of an ethnic group), 'Meo' or 'H'mong' (Lemke et al 2008). Considerable research has been conducted in order to characterize and conserve this indigenous pig breed, thereby contributing to sustain a valuable source of biodiversity (Lemke et al 2008). Research results indicate favorable meat quality traits of this breed compared to crossbreds or exotic pig breeds (Cuong 2004). The feeding requirements of the local Ban pig are lower, while disease tolerance is higher compared to other breeds (Lemke et al 2006, 2007).

However, most research on Ban pigs has been limited to technical aspects, and market information for Ban pig producers, or assessments of the market potential of Ban pigs, which is still limited. Therefore, the present study evaluates the market potential for Ban pigs in

northern Vietnam and seeks to address crucial issues from a smallholder perspective, i.e. which markets could be effectively served by Ban pork producers and whether different product requirements exist in different markets. In particular, this study is guided by the following specific objectives:

(i) Describe the current situation and general characteristics of Ban pig markets in northern Vietnam,

(ii) Identify important marketing factors and Ban pig characteristics affecting pork prices, and

(iii) Present recommendations for producers, traders, and policy makers to sustainably develop the Ban pig market and to improve the incomes and livelihoods of smallholder farmers, as well as other market participants.

Methodology

Study area and data collection

Ban pigs are mainly raised under smallholder conditions in mountainous areas of northern Vietnam. The primary market for Ban pork comprises restaurants in provinces of the lowland areas, which are the fastest growing in the country. Therefore, restaurant owners were chosen as an entry point for data collection on market issues. In fact, Ban pork is rarely found in wet markets due to its high value and final customers consume Ban pork almost exclusively in restaurants. Thus, these restaurants can be considered as key component in the Ban pork value chain. Restaurant owners have experience in searching and developing Ban supply sources, as well as meeting customer expectations.

Data collection started by making a shortlist of restaurants offering Ban pork in the lowland surroundings of the capital Hanoi and its neighboring provinces. Based on expert knowledge and a snowball sampling procedure, a shortlist of 145 restaurants selling Ban pork was compiled. Based on the list, 40 restaurants were randomly chosen. If cooperation for the survey period of one year could not be assured, random replacements were selected. After the survey period, data from 33 restaurants could be used for analysis. They were located in the following provinces: Hanoi, Hung Yen, Hai Duong, Ninh Binh (see details in Table 1).

Table 1. Distribution of restaurants by province

	Nº of restaurants	%
Province		
-Hanoi	7	21.2
-Hai Duong	10	30.3
-Hung Yen	9	27.3
-Ninh Binh	7	21.2
Restaurant area		
-Delta	16	48.5
-Mountainous	17	51.5
Total	33	100.0

A structured questionnaire was designed to collect data covering general information on restaurants, restaurant owners' perceptions of their customers, general information on purchase arrangements (buying type – for details see model description) and the activities of transporting, slaughtering and storing Ban pigs. In addition, the importance of quality attributes of Ban pork and other pork were assessed on a rating scale by the restaurant owners and information relating to marketing activities of stakeholders in the Ban supply chain was collected. Most importantly, weekly transactions for Ban pigs were recorded on a separate sheet, which additionally included details on quantity, price and quality attributes of Ban pigs for each transaction.

Surveyed restaurants are scattered in each of the four provinces. Often, restaurants are clustered in a specific so-called 'special food area'. The most important group of restaurants is located in the mountainous area of each province. Those restaurants have the advantage of approaching nearby and cheap Ban supplying sources of high quality. The size in terms of customer area of these restaurants is relatively large and many types of dishes also from different wild animals are offered. The restaurants that are located in the delta area are farther from supply sources and, hence, Ban pigs are often purchased from traders at considerably higher prices.

Empirical Model

In a competitive market, the implicit price of a product is a function of its attributes alone and not also of the characteristics any individual consumer or supplier of the product. However, empirical studies show that prices are also related to the characteristics of the buyers and sellers or marketing factors, implying some non-competitiveness in the market (Andargachew and Brokken 1993; Oczkowski 1994; Jabbar 1998). For this reason, a hedonic price model was used to evaluate the impact of different marketing and quality factors on the price of Ban pigs. The hedonic price analysis is based on the hypothesis that products have many attributes that confer utility and that the values of each attribute contributes to the final price of the product. The observed price is therefore a composite of the implicit prices of the products' and marketing channels' attributes (Rosen 1974; Lucas 1975).

The hedonic price approach was first devised by Court (1939) and then further developed (see Becker, 1965; Lancaster, 1966 and Rosen, 1974). There are several studies that have applied the hedonic model for food and agricultural products: Brorsen et al (1984) analyzed rice prices in the U.S. market; Tronstad et al (1992) used the hedonic model to the describe the U.S. apple industry; Harris (1997) employed a hedonic analysis for Frankfurter sausages; Misra and Bondurant (2000) focused on the effect of quality attributes on price of cotton-seed; Karipidis et al (2005) and Kim and Chung (2011) analysed how retail egg prices are affected by product attributes; Ojogho et al (2013) conducted a hedonic demand analysis for beef in Benin metropolis; Mendis and Edirisinghe (2013) estimated a hedonic price model to study willingness to pay for rice traits in Sri Lanka.

Our questionnaire was designed to elicit information from restaurant owners on the attributes and the specific criteria that they consider when they purchase Ban pigs. The key question was to appreciate whether such attributes have any relationship with, or influence on the price of Ban pigs.

If we assume that any unobservable are uncorrelated with observed product characteristics, the hedonic price model can be written as:

$$Ln(Price_{it})n = \beta_0 + \begin{bmatrix} \sum_{i=1}^{3} \beta_1^j \cdot BreedType_{it} \\ \sum_{i=1}^{2} \beta_2^j \cdot Weight_{it} \\ \sum_{i=1}^{2} \beta_3^j \cdot Fat_{it} \end{bmatrix} + \begin{bmatrix} \sum_{i=1}^{2} \beta_4^j \cdot CutType_{ti} \\ \sum_{i=1}^{2} \beta_5^j \cdot SellerType_{it} \\ \sum_{i=1}^{2} \beta_6^j \cdot BuyingType_{it} \\ \sum_{i=1}^{3} \beta_7^j \cdot MarketLocation_{it} \end{bmatrix} +$$

$$\underbrace{\hspace{4cm}}_{Quality\ factors} \qquad \underbrace{\hspace{4cm}}_{Marketing\ factors}$$

$$+ \sum_{i=1}^{3} \beta_8^j \cdot Season_i + \varepsilon_{it}$$

The variables in this model are explained in Table 2. Accordingly, the dependent variable is $Ln(Price_{it})$ in which $Price_{it}$ is the t_{th} wholesale price observation for the i_{th} restaurant. Price is expected to be explained by seasonality, as well as marketing and quality factors. Breed type includes Ban purebreds, exotic purebreds and Ban crossbreds, where the price for Ban purebreds is expected to be higher than for other breed types. Apart from breed type, weight and fat are the meat quality factors included in the model. For the specific case of Ban pork, pigs with heavier slaughter weights as well as higher levels of fat are expected to be cheaper. As marketing factors, cut type, seller type, buying type and market location entered the hedonic price model. The price for a whole live pig is expected to be lower than for a slaughtered pig (carcass or retail cuts). Seller type refers to the supply source of Ban pork to restaurants and is classified into three categories, i.e. traders without slaughtering, traders with slaughtering and direct supply from pig producers. The price is expected to be cheaper, if Ban pigs are bought directly from the producer. Accordingly, the variable buying type is also classified into three groups, i.e. purchases on a case-by-case basis (often single, one time transactions with a specific supplier), by verbal (informal ex-ante) contracts and on basis of long-term relationships. Thus, the variable describes the type of contract made for business transactions between the restaurant and the supplying source. Case-by-case contracts are commonly used for initial transactions, or one time transactions. Verbal contracts are nonwritten agreements between suppliers and Ban restaurants and are considered as a bilateral exchange of promises to conduct business. In this way, Ban suppliers will promise to deliver Ban pigs for restaurants, while the characteristics of the required pigs are specifically clarified beforehand. If the requirements are not met, buyers have the right to return those pigs to the suppliers. This kind of contract is popular among small or medium restaurants. In contrast, long-term contractual relationships are based on trust, mutual-understanding and empathy and therefore the partners may not need to specify the requirements of the pigs beforehand. Here, long-term contractual relationships were expected to increase prices compared to purchases made by informal agreements or on case-by-case basis. The variable market location compiled four provinces that are corresponding to the areas where the current research was conducted, i.e. Hanoi, Hai Duong, Hung Yen and Ninh Binh. We assumed that the closer the restaurants are to the supplying source, the lower the price. Ban prices are also expected to vary by season, with higher prices obtained during spring when Lunar New Year, the most important national event in Vietnam, is taking place and lower prices in the hot season when the demand for meat is low.

For the present analysis, 1944 price observations of a whole year from 33 restaurants were

available. In order to estimate the effects of the different quality and marketing factors on Ban prices, we estimated a regression model with a semi-logarithmic functional form. Semi-log specifications are easily interpreted as the slope coefficient measures the relative change in the value of the dependent variable for a given absolute change in the value of the explanatory variables. In our case all independent variables in the model are dummies (coded as 0 and 1) and therefore, the percentage change in price compared to the base variable is *100% (Chang et al 2010).

Table 2. Definitions of variables for hedonic models

Variables	Definition
Dependent Variable	
$Price_t$	The wholesale price of Ban pig per kg for the t_{th} restaurant
Independent Variables	
Breed Type$_{it}$	Dummy variable for the ith type of breed in the tth restaurant: i = 1 (exotic purebred), 2 (Ban crossbred), base=Ban purebred
Weight$_{it}$	Dummy variable for the ith range of weight per pig in the tth restaurant: i = 1 (< 12 kg), 2 (12-17 kg); base = > 18 kg
Fat$_{it}$	Dummy variable for level of fat in the ith of the tth restaurant: i = 1 (lean), 2 (medium fat); base= high fat
Cut Type$_{it}$	Dummy variable for the ith type of meat cut in the tth restaurant: i = 1 (whole slaughtered pig), 2 (half slaughtered pig); base = live pig
Seller Type$_{it}$	Dummy variable for the ith type of seller in the tth restaurant: i = 1 (trader without slaughtering), 2 = (trader with slaughtering); base=pig producer
Buying Type$_{it}$	Dummy variable for the ith type of buying in the tth restaurant : i = 1 (case-by-case), 2 (verbal contract); base=long-term relationship
Market Location	Dummy variable for the ith survey market; i = 1 (Hanoi), 2 (Hai Duong), 3 (Hung Yen); base=Ninh Binh
Seasonality$_{it}$	Dummy variable for the ith season in one year in the t_{th}

restaurant: i = 1 (spring), 2
(summer), 3 (autumn); base
= winter (previous year)

General descriptive analysis of Ban pig markets

Characteristics of Ban restaurants

General characteristics of the surveyed restaurants are summarized in Table 3. Restaurants in the delta area are often smaller in comparison to those in the mountainous areas. Tables in the delta restaurants are often arranged close together in order to efficiently utilize the space and increase the number of seats, resulting in a higher capacity of the restaurants in the delta area compared to those in the mountainous area. The number of employees is higher in the mountainous restaurants, because in the delta, the limited area and the high costs for land and labour reduce the average scale of the restaurants, especially of those located close to the city centre. Besides serving food, the restaurants in the mountainous areas nowadays also offer ecotourism like travel information or picnics in mountains and forests. Thus, these restaurants offer a wider choice of services, which explains customers' preferences for these locations. Moreover, the close distance to supplying sources is another advantage for these restaurants. Only marginal differences could be found in the owners' demographic data.

Table 3. Characteristics of restaurants

Restaurant characteristics	Delta		Mountainous		Total	
	Mean	SD	Mean	SD	Mean	SD
- Area (sqm)	677	675	1083	2079	1316	2058
- N° of seats	280	154	179	75	205	117
- N° of employees	10.2	3.1	11.3	13.4	9.3	3.9
- Distance to other restaurant (km)	1.9	1.8	1.9	1.4	1.5	1.5
Owner						
- Age (years)	44.4	11.4	42.8	8.4	43.5	12.1
- Education (years schooling)	11.5	2.4	11.1	1.9	11.8	1.5

The higher number of customers found in restaurants in the mountainous area also resulted in a higher number of Ban pigs sold per week in this area (Table 3).

Ban prices

Prices for Ban pigs considerably differed between restaurants in the delta areas and those in the mountainous areas. As can be seen in Table 4, provenance was also reflected in prices paid by restaurant owners.

Table 4. Wholesale prices of Ban pigs for restaurant owners ('000 VND/kg)

Supply source	Restaurant location					
	Delta		Mountains		All	
	Mean	SD	Mean	SD	Mean	SD
Mountainous area	95.3	13.8	90.6	17.3	93.1	15.7

Delta area	82.7	7.8	92.4	15.4	90.1	14.6

The restaurant owner's opinions on price fluctuations are shown in Table 5. Most of the restaurant owners stated that price fluctuations for Ban pigs throughout the year can be quite high, and influenced by season and special occasions, such as Tet holidays, Independence Day or other holidays. However, the restaurants in the delta area seem to experience higher price fluctuations than those in the mountainous area, as shown by the difference in ratings (1.4 vs. 1.1, respectively; Table 5). According to the restaurants, especially those in the delta area, price fluctuations are quite hard to manage, because they depend on many factors. In the mountainous area, the management of price fluctuations seems to be less difficult, which may be due to the fact that the owners have longer relationships with suppliers, who are mainly pig producers and not traders. However, price fluctuations do not seem to influence the range of dishes that are offered by the restaurants.

Table 5. Restaurant owner's opinions on Ban pig price fluctuations

Price fluctuations	Delta		Mountains		All	
	Mean	SD	Mean	SD	Mean	SD
Price for Ban fluctuates throughout the year.	1.4	0.7	1.1	0.7	1.2	0.7
Price fluctuations of Ban are difficult to manage.	1.3	0.7	0.6	0.7	1.0	0.8
If Ban prices were more predictable and stable, I would be able to increase my sales of Ban dishes.	0.1	1.0	-0.2	1.0	0.1	1.0

Note: Fully agree (+2); Partly agree (+1); Neutral (0); Partly disagree (-1); Fully disagree (-2)

Hedonic price model analysis

Table 6 summarizes the results of the hedonic price model for Ban pigs in each of the surveyed provinces, as well as for the whole sample. F-values range from 33.1 to 323, which corresponds to a significance level of 1%. The R^2 values of the models range from 54% for the Hanoi market to 90% for the Hung Yen market. The resulting coefficients show the expected signs and the statistics suggest that the models fit the data well, especially for Hung Yen market, where 90% of the variance in Ban pig price (per kg) is explained by the variables in the model. In sum, the model results indicate that quality attributes, marketing factors and season of sale were significant factors influencing the market price over one year in the study area.

Quality factors

In all provinces, Ban crossbreds received about 9% lower prices than purebred Ban. This price discount reflects the higher meat quality associated with pure Ban pork. Particularly in Hanoi, the percentage difference in price between crossbred and purebred Ban pork accounted for 13%, implying that consumers in Hanoi have an even higher willingness to pay for high quality meat of pure Ban.

The regression results for each province indicate that exotic purebreds with high lean meat content were also purchased at a 11-22% lower price by restaurants in comparison to Ban purebreds. This considerable price difference in combination with information asymmetries

on the quality of Ban pork tempted owners of small restaurants to mix pork of exotic pig breeds with pork from Ban pigs, particularly those with a low reputation regarding food quality. This practice has been confirmed by some owners of restaurants in our survey. After being processed into different meals, customers cannot distinguish mixed pork dishes from pure Ban pork dishes. In Hai Duong and Ninh Binh, where restaurants are mainly allocated in the mountainous areas, pork from exotics does not appear in Ban dishes, explaining customers' preference for restaurants in those areas. This is further supported by the plans of 71% of the restaurant owners in the mountainous areas to expand their business within the next 12 months, as compared to only 42% in the delta areas.

Due to the high price of Ban purebreds and the insufficient supply, only restaurants in the mountainous area such as in Ninh Binh province, regularly purchased purebred animals. In most of the surveyed restaurants, Ban crossbreds are the most regularly used breed type.

Other factors affecting Ban prices included the average weight per live pig. For analysis, the average weight per live pig was divided into three categories, i.e. less than 12 kg, 12-18 kg and more than 18 kg (base variable). From the results in Table 6 it can be seen that in all provinces Ban pigs with an average weight smaller than 12 kg were offered at 4-17% higher prices in comparison to pigs with an average weight of more than 18 kg, particularly in Ninh Binh province. This is due to the fact that the bigger and the older Ban pigs are, the higher the fat content. In addition, it is believed that Ban pigs of high weight are fed on commercial concentrates. According to restaurant owner's opinions, the preferred average weight per live pig is below 15 kg. Surprisingly, the level of fat was not significantly affecting Ban pork prices in almost all provinces, except for Hai Duong. We suppose that this is a result of the low fat levels in pork from pure Ban pigs.

Marketing factors

Regarding the marketing factors, trading partner and cut type significantly influenced Ban pig wholesale prices. As expected, prices increased with the level of marketing services offered by traders, i.e. if traders slaughter pigs, prices will be higher compared to the wholesale price of live pigs. This is suitable for small restaurants, which cannot sell a whole pig in a day, and therefore buy a slaughtered pig or pork cuts. More interesting are the effects of buying arrangements. In comparison with transactions based on long-term contractual arrangements, prices for Ban pigs purchased on a case-by-case basis (initial or one time transactions) or by informal agreements were marginally higher. The restaurants only give way to non-recurring transactions, if their established long-term suppliers are out of stock or cannot deliver Ban pigs. Therefore, these buying arrangements are often due to supply shortages and involve higher prices in the range of 1-5%, depending on the province, in comparison to transactions on basis of long-term relationships. In Vietnam, a verbal contract illustrates high mutual trust between sellers and buyers, which should reduce transaction costs and therefore should lower prices. However, in contrast to established long-term contractual relationships, purchasing Ban through verbal contracts implies that the restaurants declare their requirements in advance. Therefore, Ban purchased through this arrangement has more specific requirements than for transactions within long-term relationships, which resulted in 6-9% higher prices, depending on the respective province.

The applied model also allowed a comparison of wholesale prices in different markets: Ban pigs in Ninh Binh were cheaper than compared to Hanoi, Hai Duong and Hung Yen provinces. A possible reason for the difference here could be the structure of the marketing channel, which is shorter and directly from producers. Therefore, as restaurants in Ninh Binh are located more upstream in the supply chain, their ability to access supply sources was

easier and the lower price reflects lower transaction costs. In comparison to the other three provinces located closer to industrial centers, the purchasing power of restaurants in Ninh Binh province is also lower. Among the four provinces, the highest wholesale prices for Ban were offered in Hanoi. High transportation costs simply increase the prices for Ban and other products in Hanoi compared to other provinces.

Table 6. Hedonic model estimation results for Ban pig prices

Variables	All n= 1946	Hanoi n= 445	Hai Duong n= 554	Hung Yen n=570	Ninh Binh n=377
Intercept	4.27*** (301)	4.36*** (126)	4.37*** (237.87)	4.36*** (237)	4.16*** (134)
Quality characterists					
Exotic purebred	-0.19*** (-8.98)	-0.25*** (-5.05)	-0.19*** (-2.91)	-0.12*** (-7.41)	-
Ban crossbred	-0.09*** (-12.8)	-0.14*** (-7.88)	-0.08*** (-9.25)	-0.04*** (-3.99)	-0.014 (-0.85)
<12kg	0.02 (1.64)	0.003 (0.09)	0.02 (1.57)	0.04*** (3.01)	0.15*** (5.65)
12kg-18kg	0.05*** (4.94)	0.07* (2.52)	0.02 (1.61)	0.02* (1.90)	0.12*** (5.28)
Lean	-0.01 (-1.06)	-0.02 (-1.24)	0.003 (0.33)	0.007 (-1.09)	-0.06*** (-4.23)
Medium fat	-0.001 (0.08)	0.05 (1.37)	-0.03* (-2.08)	0.0003 (-0.02)	-0.01 (-0.66)
Marketing Factors					
Trader without slaughtering	0.08*** (11.9)	0.18*** (8.12)	0.04*** (3.29)	-0.005 (-0.51)	0.08*** (6.87)
Trader with slaughtering	0.06*** (5.46)	0.13*** (5.70)	0.15*** (3.07)	-0.08*** (-4.14)	0.07*** (3.11)
Case-by-case	0.01*** (2.30)	0.01 (0.86)	0.01 (1.51)	0.03*** (2.81)	0.05*** (2.93)
Verbal contract	0.05*** (6.99)	0.07** (2.05)	0.09*** (8.24)	-0.02** (-2.36)	0.06*** (4.79)
Whole slaughtered pig	0.23*** (15.6)	0.33*** (7.16)	0.14*** (7.44)	0.30*** (13.24)	0.19*** (6.39)
Half slaughtered pig	0.25*** (18.3)	0.21*** (4.87)	0.11*** (6.01)	0.23*** (14.5)	0.37*** (17.1)
Hanoi	0.08*** (9.77)				
Hai Duong	0.06*** (7.36)				
Hung Yen	0.06*** (8.50)				
Seasonal factors					
Spring	0.16*** (26.8)	0.13*** (7.34)	0.17*** (21.18)	0.18*** (28.0)	0.16*** (11.4)
Summer	0.26*** (39.2)	0.17*** (8.79)	0.28*** (33.2)	0.36*** (47.4)	0.25*** (17.0)
Autumn	0.39*** (55.2)	0.32*** (15.5)	0.41*** (46.9)	0.47*** (57.7)	0.37*** (23.1)
R-squared	0.69	0.54	0.85	0.90	0.73
F-value	237***	33.1***	200***	323***	71.1***

Notes: the dependent variable is the natural logarithm of the wholesale price paid by a restaurant owner in '000 VND/kg
*** p <0.01; **p<0.05; *p<0.1; - variable not included in the model.
Numbers in brackets are values of t-statistics

Seasonal factors

All coefficients for season are significant at the 1% level. The results indicate that the wholesale price for Ban increases throughout the seasons, from winter through spring and summer to autumn. Indeed, the winter season was chosen as the base level to capture seasonality effects: the winter season corresponds to October-December 2010, followed by spring from January to April 2011, summer from May to July 2011 and autumn from August to September 2011.

Price increases of Ban pork within the survey period could indicate general price inflation and mask seasonality effects, because the consumer price index (CPI) of the country increased by approximatly 20% in the survey period (GSO, 2011). However, the coefficient for the autumn season shows that the price was higher by around 48% compared to the winter season, i.e. a price increase that is considerably higher than would be expected when only considering general price inflation. Conversely, prices increased more slowly in the summer by 29% as compared to the winter reference period (a price increase of around 4% (GSO, 2011) could have been expected by general price inflation) indicating relatively lower demand for pork in the hot season. The strongest price increase compared to the previous season is from winter to spring. Strong seasonality effects of Ban pork prices indicate some mismatch of demand and supply along the seasons. Price increases of Ban pork that are higher than the general price inflation indicate an increasing supply shortage of Ban pork within the considered survey period.

Discussion and conclusions

The results of the hedonic price model analysis indicate that farmers could gain higher prices, if they would be able to supply Ban pigs that possess preferred customer attributes with respect to marketing and quality aspects during the right time of the year (season). The results showed that significantly higher prices could be obtained for purebred Ban pigs with a low slaughter weight and moderate fat content. However, the currently high demand for Ban pigs cannot be met by purebreds and thus, crossbreds are used to fill the supply gaps. In addition, crossbred Ban pigs are increasingly fed on a commercial basis in order to increase live weights, resulting in the corresponding negative effects on meat quality and prices. Ban pigs that are extensively or semi-intensively raised on natural feedstuffs receive higher prices from both, restaurants and customers.

The results also indicated that the peak selling period of the year is spring, which coincides with the Lunar New Year, followed by the winter season. Accordingly, farmers could take advantage by fattening schemes that are adjusted to these seasons. The most important issue for the restaurant owners appears to be a secure supply source delivering high quality of Ban pigs. Among the four surveyed markets in Hanoi, Hai Duong, Hung Yen, Ninh Binh, restaurants in Ninh Binh province paid the lowest purchasing price, which is due to the fact that their suppliers are mainly producers. These direct marketing links through short supply chains allowed restaurant owners in more distant provinces to offer their Ban dishes to customers at lower prices, partly at the expense of producers. Particularly for the uplands of northern Vietnam, Herold et al (2010) proposed a short food supply chain system to better organize pig breeding and marketing channels in remote areas. Moreover, promoting transactions based on long-term contractual arrangements between producers and restaurant's owners is an option that policy makers should consider to sustain growth through Ban pork production.

An alternative approach builds on long-term research in the northern mountainous region of Vietnam developing a conceptual and analytical framework for the initiation and implementation of a community-based breeding program (CBP) and its subsequent

systematic transfer into a profitable, self-sustained breeding and marketing program (CBMP) for pork produced with local pig breeds (Valle Zárate and Markemann 2010). The currently implemented CBMP counts on the involvement of a private breeding company, the regional extension service and the national research institute. The organizational set-up is sought to safeguard a sustainable and cost-efficient transfer and is based on results of Roessler et al (2012), who identified breeder cooperatives as the most promising option for breeding management on communal level in North Vietnam. Moreover, from a theoretical background Herold et al (2012) showed that the current structural and organizational planning of the CBMP may increase the competitiveness of smallholder breeders on village level on the one hand, and provide an incentive system for a systematic conservation of the local pig breeds on the other hand.

Finally, it should be noted that the quality of Ban pork is the leading concern of both, restaurants and customers. The difficulty of some customers distinguishing between 'real' Ban pork and crossbreds of lower quality contributed to a free-rider problem caused by information asymmetries, which seriously compromises customer satisfaction and trust and could ultimately lead to market failure. Thus, the establishment of a quality control system within the marketing chain offers an effective measure to provide product traceability from the producer to the consumer level, as well as to achieve higher prices. Such quality control and traceability system is also an integral part in the set-up of the implemented CBMP mentioned above. The systematically organized exploitation of the special quality characteristics of the Ban pig (Hau 2008; Huong et al 2009) would concurrently result in appropriate benefits for the rural poor and a sustainable utilization of a valuable local genetic resource.

Acknowledgements

References

Andargachew K and Brokken R F 1993 Intra-annual sheep price patterns and factors underlying price variations in the central highlands of Ethiopia. Journal Agricultural Economics, 8:125-138.

Becker G S 1965 A Theory of the allocation of time. Economic Journal, 75:493-517.

Brorsen W B, Grant W R and Rister M E 1984 A hedonic price model for rough rice bid/acceptance markets. American Journal of Agricultural Economics, 66:156-163.

Chang, J B, Lusk, J L, Norwood 2010 The Price of Happy Hens: A Hedonic Analysis of Retail Egg Prices. Journal of Agricultural and Resource Economics, 35(3):406–423

Court A T 1939 Hedonic price indexes with automotive examples in the dynamics of automobile demand. New York: The General Motors Corporation.

Cuong T H 2004 Study on current and potential market supply and demand, marketing opportunities and consumer preferences for indigenous breed animals/products. Market and Marketing GEF-UNDP 2715-03-4709. Final Report. Development and Application of Decision-Support Tools to Conserve and Sustainably Use Genetic Diversity in Indigenous Livestock and Wild Relatives Livestock, Hanoi, Vietnam. Available at: http://www.fangrasia.org/admin/admin_content/files/83769.pdf.

Gerbens-Leenes P W, Nonhebel S and Krol M S 2010 Food consumption patterns and economic growth. Increasing affluence and the use of natural resources. Appetite, 55: 597–608.

GSO (General Statistical Office) 2010 Statistical Yearbook Vietnam 2010. Statistical Publishing Hourse, Hanoi, Vietnam.

GSO (General Statistical Office) 2011 Consumer price index, gold and USD price indexes. Available at: http://www.gso.gov.vn/default_en.aspx?tabid=625, Accessed March 2012.

Harris M J 1997 The impact of food product characteristics on consumer purchasing behavior: The case of Frankfurters. Journal of Food Distribution Research, 28(1):92–97.

Hau N V 2008 On farm performance of Vietnamese pig breeds and its relation to candidate genes. PhD Thesis, Institute of Animal Production in the Tropics and Subtropics, University of Hohenheim, Stuttgart, Germany. Cuvillier Verlag, Göttingen, Germany.

Herold P, Roessler R, Valle Zárate A and Momm H 2012 Development of organisation and planning in animal breeding: I. A review on breeding organization. Archives Animal Breeding, 55(4):402-414.

Herold P, Roessler R, Willam A, Momm H and Valle Zárate A 2010 Breeding and supply chain systems incorporating local pig breeds for small-scale pig producers in Northwest Vietnam. Livestock Science, 129:63-72.

Huong P T M, Hau, N V, Kaufmann B, Valle Zárate A and Mergenthaler M 2009 Emerging supply chains of indigenous pork and their impacts on small-scale farmers in upland areas of Vietnam. 27th Conference of the International Association of Agricultural Economists (IAAE), August 16-22, 2009, Beijing, China.

Jabbar M A 1998 Buyer preferences for sheep and goats in southern Nigeria – A hedonic price analysis. Agricultural Economics, 18:21-30.

Karipidis P I, Tsakiridou E, Tabakis N M and Mattas K 2005 Hedonic analysis of retail egg prices. Journal of Food Distribution Research, 36:68-73.

Kearney J 2010 Food consumption trends and drivers. Philosophical Transactions of the Royal Society B, 365: 2793–2807.

Kim C and Chung C 2011 Hedonic analysis of retail egg prices using store scanner data: An application to the Korean egg market. Journal of Food Distribution Research, 42(3):14-27.

Lancaster K 1966 A new approach to consumer demand theory. The Journal of Political Economy 74(2):132-157.

Lapar L and Toan N N 2010 Demand for pork by Vietnamese consumers: Implications for pro-poor livestock policy and development agenda in Vietnam. Improving the competitiveness of pig producers in Vietnam. Project Brief No. 1, ILRI, Nairobi, Kenya.

Lapar L, Luan N N, Jabbar M A, Fuguié M, Quang H V, Moustier P, Binh V T and Staal S 2010 Estimating willingness to pay for quality and safety attributes of pork: Some empirical evidence from northern Vietnam. ILRI Research Report 24. Nairobi, Kenya, pp. 138-159.

Lemke U, Mergenthaler M, Roessler R, Huyen L T T, Herold P, Kaufmann B, Valle Zárate A 2008 Pig production in Vietnam – a review. CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources, 3:1-15.

Lemke U, Kaufmann B, Thuy, L T, Emrich K and Valle Zárate A 2007 Evaluation of biological and economic efficiency of smallholder pig production systems in North Vietnam Evaluation of biological and economic efficiency of smallholder pig production systems in North Vietnam. Tropical Animal Health and Production, 39(4):237-254.

Lemke U, Kaufmann B, Thuy L T, Emrich K and Valle Zárate A 2006 Evaluation of smallholder pig production systems in North Vietnam: Pig production management and pig performances Evaluation of smallholder pig production systems in North Vietnam: Pig production management and pig performances. Livestock Science, 105(1-3):229-243.

Lipoeto N I, Geok Lin K and Angeles-Agdeppa I 2013 Food consumption patterns and nutrition transition in South-East Asia Food consumption patterns and nutrition transition in South-East Asia. Public Health Nutrition, 16(9):1637-1643.

Lucas R E B 1975 Hedonic price functions. Economic Inquiry, 13:157-178.

Mendis S and Edirisinghe J C 2013 Willingness to pay for rice traits in Kurunegala and Hambantota districts: an application of a spatial hedonic pricing model. Journal of Agricultural Sciences, 8(1):1-7.

Mergenthaler M, Weinberger K and Qaim M 2009 Consumer valuation of food quality and food safety attributes in Vietnam. Review of Agricultural Economics, 31(2):266-283.

Misra S K and Bondurant J 2000 The role of product and market characteristics in determining cottonseed prices. Agribusiness, 16(3):357–366.

Oczkowski E 1994 A hedonic price function for Australian premium table wine. Australian Journal of Agricultural and Resource Economics, 38(1):93-110.

Ojogho O, Erhabor P O, Emorako C O and Egware R A 2013 Hedonic demand analysis for beef in Benin Metropolis. Global Journal of Agricultural Sciences, 12(1):91-99.

Pedregal V D, Luan N N, Fuguié M and Moustier P 2010 Familiarity with consumer expectations to support smallholders: Demand for quality pork in Vietnam. In: Owen E, Smith T, Steele, M A, Anderson S, Duncan A J, Herrero M, Leaver J D, Reynolds C K, Richards J I and Ku-Vera J C (Eds.), Responding to the livestock revolution: the role of globalisation and implications for poverty alleviation. Nottingham University Press, Nottingham, UK, pp. 127-137.

Pingali P 2007 Westernization of Asian diets and the transformation of food systems: Implications for research and policy. Food Policy, 32:281-298.

Phuong N V, Cuong T H and Mergenthaler M 2014 Effects of socio-economic and demographic variables on meat consumption in Vietnam. Asian Journal of Agriculture and Rural Development, 4(1): 972-987.

Roessler R, Herold P, Momm H and Valle Zárate A 2012 Organisation of breeding under difficult framework conditions – the case of smallholder pig breeding in mountainous areas in Northwest Vietnam. Archives Animal Breeding, 55(6):590-602.

Rosen S 1974 Hedonic prices and implicit markets: Product differentiation in pure competition. Journal of Political Economy, 82:34-35.

Singh D N, McPhee C P and Kopinski J S 1996 Helping to improve pig production in Vietnam. In: Pryor, W.J. (Ed.), Exploring approaches to research in the animal sciences in Vietnam: A workshop held in the city of Hue, Vietnam, 31 July-3 August, 1995. ACIAR Proceedings No. 68:176-181.

Tisdell C 2010 The growing shortfall in Vietnam's domestic supply of pork: Significance and policy implications. Improving the competitiveness of pig producers in Vietnam. Project Brief No. 2, ILRI, Nairobi, Kenya.

Tronstad R, Huthoefer L S and Monke E 1992 Market windows and hedonic analyses: An application to the apple industry. Journal of Agricultural and Resource Economics 17(2):314-322.

Valle Zárate A and Markemann A 2010 Community-based breeding programmes incorporating local breeds: Concept, research results and implementation strategy on pigs in Northern Vietnam. Proc. of the 9th World Congress on Genetics Applied to Livestock Production (WCGALP), 1-7 August 2010, Leipzig, Germany, p. 0845.

Vu T 2003 The political economy of pro-poor livestock policy-making in Vietnam. PPLPI Working Paper No.5, FAO, Rome, Italy.