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PIG PRODUCTION AND RISK EXPOSURE: A CASE STUDY IN HUNG YEN, VIETNAM

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ABSTRACT

The effects of direct and indirect input factors on pig productivity and its production risk in Hung Yen, Vietnam, were investigated. In using a moment-based approach, a Cobb-Douglas production function was applied to capturing mean, variance, and skewness effects. The results of this study showed that the expenditure for feed and time length of production reduced both the variation in productivity and downside risk, whereas an expanding production scale increased both the variation in productivity and downside risk.

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1 INTRODUCTION

Pig production plays an important role in Vietnam. In 2011, Vietnam had more than 4 million households producing pigs, accounting for about 43% of total agricultural households. Among types of meat consumed, pork is ranked as the most important meat. According to Son (2007), pork accounted for about 80% of total meat consumed in 2005. Over time, demand for pork has decreased, but it has still remained 57% in 2010 (Nga *et al.*, 2013).

Hung Yen is one of the leading provinces in pig production, which is also an important activity of farmers in Hung Yen, with contributions of more than 65% and 40% to income of pig producers and gross output of agricultural production of the province, respectively. However, pig producers in Vietnam in general and in Hung Yen province in particular face a number of difficulties in which production risk, including factors that lead to instability in productivity is one of the quintessential features, especially for small scale farmers (Hardaker *et al.*, 1997). Those factors may be diseases, feeds, farming practices, and weather. However, weather is uncontrollable factors, so it will not be investigated in this paper. Recently, in practice, there are a number of common diseases influencing pig production such as Foot and Mount Disease (FMD), Porcine Reproductive and Respiratory Syndrome (PRRS), Classical Swine Fever (CSF), Porcine High Fever Disease (PHFD), and Swine Influenza (H1N1). Those diseases are predominantly occurring to small scale producers due to their poor farming practices and their poor abilities to access high quality veterinary services (Nga *et al.*, 2013). Moreover, knowledge plays an important role in pig production. Consequently, the Vietnamese Government has provided extension services to farmers such as short training courses, technology transfer by doing demonstration practices, supporting research for development… Nevertheless, those services have mainly focused on the promotion of crop rather than livestock production.

This paper aims to investigate factors contributing to variation of the productivity/risk exposure. The paper includes four sections. In the next section, research methods, including reviewing of theory and method of estimation are explored while the finding and implication are presented in the following section. Concluding section ends the paper.

2 METHODS

2.1 Literature review on risk assessment

There are at least two common agreements in the literature about production risk in agricultural production. The first is that risk assessment of agricultural production is important and is receiving more and more attention of agricultural economists (Just and Pope, 1979; Falco and Chavas, 2009). The second one is that production risks in agriculture are necessary to distinguish downside risk (unexpected bad events) and upside risk (unexpected good events). In addition, the evaluation of the mean and variance effects is standard to measure risk (Just and Pope, 1979). On that basis, considering the skewness risk analysis seems to be crucial to investigate driven factors of downside risk with a sense that an increase in skewness of productivity means a reduction in downside risk exposure (Falco and Chavas, 2009). Another noticeable point is that there are plenty researches on risk assessment in crop production. For example, Falco and Chavas (2009) conducted risk exposure in crop production of biodiversity in the Highlands of Ethiopia. Antle (2010) also determined production risk of Ecuadorian potato production etc. There are also many other studies on risk assessment in aquaculture such as salmon or in livestock, and dairy farm. However, there are a few researches on production risk analysis in pig production, especially in Vietnam. The risk analysis is expected to give solutions to improve and stabilize pig productivity and improvement of distribution of value added for pig production, especially for pig farmers.

2.2 Conceptual Framework and Model

Risk was estimated based on willingness to pay for a risk reduction program such as risk insurance (Sanglestsawai, 2012). Then, the following steps were used to estimate risk:

Firstly, starting from the utility function developed by Neumann-Morgenstern:

$$EU(\pi) = EU[p.g(x,v) - c(x)] \qquad (1)$$

Where: $EU(\pi)$ is expected utility of income; g(x,v) is production function; P is output price; C(x) is input costs.

Following, from function (1), Pratt (1964) developed an alternative function:

$$EU(\pi) = U[E(\pi) - R] \qquad (2)$$

Where: $E(\pi)$ is expected income; U is utility; R is a risk premium measuring the cost of private risk bearing.

From function (2), Falco and Chavas (2009) estimated risk as the following function:

$$U\big(E(\pi)\big) + \frac{1}{2}\left(\frac{\partial^2 U}{\partial \pi^2}\right)E[\pi - E(\pi)]^2 + \frac{1}{6}\left(\frac{\partial^3 U}{\partial \pi^3}\right)E[\pi - E(\pi)]^3 \approx U\big(E(\pi)\big) - \left(\frac{\partial U}{\partial \pi}\right)R \qquad (3)$$

In short, the function (3) can be rewritten as follows:

$$R = \frac{1}{2}r_2 M_2 + \frac{1}{6}r_3 M_3 \qquad (4)$$

Where: $M_i = E[\pi - E(\pi)]^i$ is i^{th} central moment of the distribution profit; $r_2 = \left({\partial^2 U}/{\partial \pi^2}\right) \Big/ \left({\partial U}/{\partial \pi}\right) > 0$ is the Arrow-Pratt coefficient of absolute aversion. It gives the intuitive result that any increase in the variances of profit tends to increase the private cost of risk bearing; $r_3 = -\left({\partial^3 U}/{\partial \pi^3}\right) \Big/ \left({\partial U}/{\partial \pi}\right) > 0$ that the risk premium tends to decrease with a rise in skewness under downside risk aversion.

Function (4) gives information about the relationship between risk premium and the i^{th} central moment of profit. However, based on the function (1), with an assumption that output price and input prices are fixed and positive, i^{th} central moment of profit will be approximately equal to i^{th} central moment of the production function. Hence, in order to investigate factors influencing risk, factors affecting i^{th} central moment of production function will be examined.

The evaluation of the mean and variance does not distinguish between unexpected bad events and unexpected good events. Hence, it is important to consider skewness in risk assessment. Factors increasing variance and decreasing skewness will increase risk. This relationship is shown in mean, variance and skewness functions from (5) to (7).

$$E[g(x,v)] = f_1(x,\beta_1) \qquad (5)$$

$$E[(g(x,v) - f_1(x,\beta_1)^2] = f_2(x,\beta_2) \qquad (6)$$

$$E[(g(x,v) - f_1(x,\beta_1)^3] = f_3(x,\beta_3) \qquad (7)$$

2.3 Production Function and Data Information

Pig productivity has been analyzed with the common use of the Cobb-Douglas production function. For example, Aggelopoulos *et al.* (2006) utilized the Cobb-Douglas production function for productivity analysis of pig farms in Greece in conjunction with their size. Moreover, in the study of production contracts and productivity in the U.S. Hog Sector, Key and McBride (2003) also used the same production function form. Again, the Cobb-Douglas production function was also used by Sharma *et al.* (1999) on the study of technical, allocative and economic efficiencies in swine production in Hawaii. Therefore, in this paper, the Cobb-Douglas production function was used to examine factors contributing to productivity and risk exposure.

Regarding to independent selected variables, it illustrated that technological progress was localized (Acemoglu, 2014). It means an innovation may work with a certain combination of inputs and its neighbors, but it may not work with those being far from the starting combination. Hence, it is necessary to work out which combination results in high production productivity. Furthermore, it is also indicated that a new innovation is often somehow similar or related to current practice (Acemoglu, 2014). Therefore, research on the improvement of productivity and elimination of risk should start from current practice and try with small interventions. Based on the above arguments, a production function with independent variables reflecting current practice will be used to explore critical points that help to increase productivity and to eliminate risk. Output (Y) represents a weight gain per month of pigs (in kg). Characteristics of household leaders related to making decisions in pig productions were included in the model to see how they affect productivity variation and risk exposure (Sharma *et al.*, 1996; Sharma *et al.*, 1999). In practice, we estimated the function with many independent variables of direct and indirect inputs and test the fitness of different models and statistically significant of variables. Finally, input variables used in the model were presented in Table 1.

Table 1: List of variables and definition of descriptive statistic

Variable	Definition	Mean	Std. Dev.	Min	Max
Inc_non_agri	Income of non-agriculture (1000VND)	47131.1	69771.7	0	606000
Vet cost	Vet service cost (1000 VND)	77.8	103.1	0	1000
Scale	Number of pigs per litter (head)	15.6	8.2	2	41
No_Training	Number of family members trained on pig production	0.8	0.7	0	3
Pri_activity	Primary activity of house leaders (1=pig production, 0=not pig production)	-	-	0	1
Not all in all out	Applying “all in all out rule” (1=not applying, 0=applying)	-	-	0	1
Feed cost	Feed cost (1000 VND/100kg output)	2835.7	633.0	601.4	4811.6
Time	Time length of a production cycle (days)	145.2	21.4	60.0	187.0

Source: Survey data in 2013 by International Livestock Research Institute – Vietnam National University of Agriculture (ILRI - VNUA)

The study was drawn on the survey data collected by the International Livestock Research Institute - Vietnam National University of Agriculture (*ILRI-VNUA)* in 2013. There were 180 households included in the survey. The content of the survey includes some parts such as (a) general information about the household, (b) production resources, (c) general information about pig production of the household, (d) production costs and selling details for the latest cycle, (e) farmer’s behavior in responding changes from the production environment, and (g) other issues related to policies supporting for the development of pig production and food safety.

3 RESULTS AND DISCUSSION

The variation of pig productivity was represented in the Figure 1. On average, productivity of pig production of households surveyed is about 22 kg per head per month (Mean). The number of households having a productivity of 20 kg per head per month is the largest with 36 households (Mode). It can be seen that the distribution of pig farm productivity skewed off at the right angle. This means that there were certain pig farms with much higher productivity in comparison to average of productivity, weight gain per month of the total sample. In other words, there was production risk existing and it was necessary to investigate factors creating upside risk (unexpected good events).

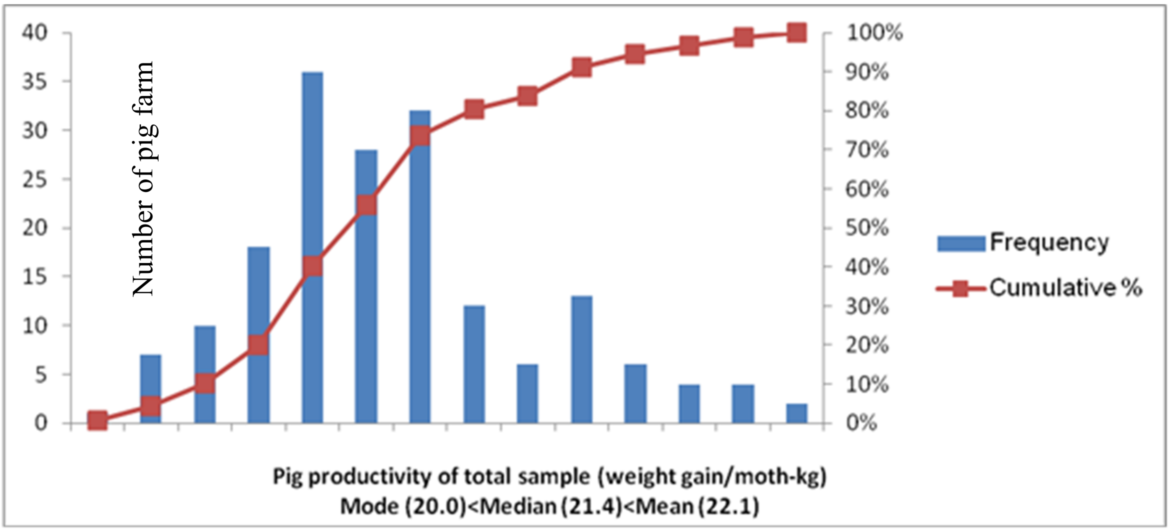

Fig. 1: Histogram of pig productivity (Weight gain (in kg) per month)

Source: Survey data in 2013 by ILRI - VNUA

The resulting econometric estimates were reported in Table 2. In the mean function, feed cost per unit output and time length of a production cycle were positive and statistically significant effects, whereas the number of pigs producing in a production cycle was negative and statistically significant effect on pig farm productivity. This can be explained that expenditure on feed included industrial feed and traditional feed. Industrial feed was much more expensive than traditional feed. Therefore, if households have a larger part of industrial feed, their expenditure for feed should be higher than households with a small part of industrial feed. Moreover, industrial feed may have higher nutritional value and better balance of nutrition. Consequently, productivity of pigs fed by the more industrial feed may be higher than other pigs.

In relation to the time length of a production cycle, a possible explanation was that pig producers in Hung Yen raised pigs on the second stage of production in the production curve of Cobb-Douglas production function. In Hung Yen, exotic breed and cross breed with a large part of exotic blood were used. Therefore, live weight of pigs was quite high, reaching at 150 kg per head. However, most of farmers sell their pigs at around 100 kg per head. It seems that their pigs had not been matured at selling time. As a result, an increase in growing time still leads to an increase in pig productivity.

In terms of production scale, research sample does not include large farms with high fixed cost and modern equipment. Farmers included in the study are smallholders raising pigs in simple pig houses in a small area of land surrounding their houses. Therefore, an increase in the number of pigs produced may cause a poor environment for pigs to live. Pig manure and waste water is kept in pig cells or in surrounding area. This consequently affects their growth rate.

The regression results indicated that feed cost and time length of a production cycle had negative and statistically significant effects on the variance function, but positive and statistically significant effects on the skewness function. This means both feed cost and time length of production reduced variation in productivity and downside risk. In contrast, production scale had positive and statistically significant effects on the variance function, but negative and statistically significant effect on the skewness function. Hence, it did not only increase the variation in productivity, but also increased downside risk.

Table 2: Estimation results of the Mean, Variance, and Skewness Function (Three-stage Least squares)

Variable	Mean Function $f_1(x,\beta_1)$		Variance Function $f_2(x,\beta_2)$		Skewness Function $f_3(x,\beta_3)$	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Intercept	-14.405**	2.398	112.617**	14.882	-996.663**	135.916
Inc_non_agri	-0.007	0.007	0.041	0.046	-0.370	0.424
Vet_cost	-0.020	0.027	0.166	0.167	-1.390	1.527
Scale	-0.245*	0.126	1.595*	0.784	-14.092*	7.162
No_Training	0.009	0.015	-0.045	0.091	0.467	0.833
Pri_activity	-0.115	0.136	0.754	0.847	-6.814	7.733
Not all in all out	-0.187	0.132	0.915	0.817	-8.795	7.459
Feed cost	1.815**	0.302	-9.160**	1.875	80.672**	17.124
Time	0.806	0.467	-9.190**	2.898	82.404**	26.469
F	9.35**		9.32**		8.83**	

*Note: SE: Standard Error; n=180; R^2=0.30; *, and ** are significant levels at 5% and 1%, respectively*

Source: Estimation from survey data in 2013 by ILRI – VNUA

4 CONCLUSIONS AND ECOMMENDATIONS

The effects on the skewness captured the exposure to downside risk. It found that expenditure for feed and time length of production reduced both the variation in productivity and downside risk, whereas an increase in the number of pigs produced increased both the variation in productivity and downside risk. Therefore, better investment in pig feed, lengthen production time and improvement of living environment, especially for large scale producers can be the strategies that can help to increase and stabilize productivity of pig production performance in Hung Yen.

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